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Economic Burden of Sand Dredging on Artisanal Fishing in Lagos State, Nigeria

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Abstract

Increasing demand for sand for construction purposes has made river/sea sand dredging a major threat to aquatic habitat and fishing. The study compared the cost and returns of artisanal fishermen in river sand dredging and non-dredging in selected fishing communities in Lagos state. The study showed that there were no significant differences in the average ages and experience in fishing of fishermen in sand dredging and non-dredging areas. However, there were significant differences in the average turbidity of river water and quantity of fish caught per labour hour by fishermen in dredging and non-dredging areas. The low productivity in sand dredging area is attributed to the negative effect sand dredging. Fishermen in non-sand dredging areas earned higher gross profit per day. The need for government to control the activities of the sand dredgers in fishing communities is recommended for the sustainability of the environment and fishing in the study area.

Keywords: Sand dredging; Turbidity; Artisanal fishing; Cost and returns; JEL: K32, Q5, Q56, D61

Introduction

Fishery is an important agricultural sub-sector in Nigeria. Fisheries resources can be broadly classified into: Artisanal fisheries (85%), industrial fisheries (14%), and culture fisheries (1%) [1]. Artisanal fishing is a subsistence fishing practice involving the use of simple tools such as throw nets and drag nets, rod and tackle as well as the traditional fishing boats. According to Faturoti, artisanal Fisheries, that is small scale fisheries provide more than 82 per cent of the domestic fish supply, giving livelihoods to one million fishermen and up to 5.8 million fisher folks in the secondary sector comprising processing, preservation, marketing and distribution [2]. Bada submitted that, apart from depending on fishing as their means of livelihood, 75 per cent of artisanal fishing households' animal protein intake comes from fish [3]. They revealed that the fisheries sub-sector contributes about 5% to the Gross Domestic Product and this is significant through export of shrimps. Based on estimates, Nigeria requires about 2.1 mmt of fish/year but produces only 0.65 mmt and imports over 900 mmt/year at a value of US$800 m to meet this shortfall.

Lagos state is one of the Nigerian coastline states dotted with many fishing communities. The coastline is about 180 km long and it is generally characterized by steep sandy beaches, offshore wave breakers and littoral drift. Some of important fishing communities in Lagos state are Badore, Agbowa, Ikosi and Oreta, Ibeshe, Ipakodo, Yovoyan, Moba, Majidun, Avijio and Itoikin (Figure 1). According to Sustainable Fisheries Livelihood Programme, these fishing communities are characterized by high population density which encourages overexploitation of fisheries resources. Aside from high population density, other human activities such as sand dredging which has continue to spread in many fishing communities as a result of high demand for sand for construction purposes may also pose a difficult challenge to food security and employment opportunities in the fishing communities (Figure 2) [4].

Sand dredging is an activity of harvesting the sand by excavation at least partly underwater [5]. Sand and gravel are essential materials for construction and high-quality material is often found in rivers and shallow seas [6-8]. According to Kim et al. sand is a critical input for construction in industrial as well as developing nations [9]. Combined with aggregate and cement, the resulting concrete is used for buildings, roads and pipes, among many other uses. Dredge et al. posited that Lagos may be the place with the highest sand need in Nigeria, if not in Africa, presently; especially with the development of the World Bank-financed Lagos Mega City project, the Eko Atlantic City and innumerable residential and industrial estates, the proposed Eko Energy City, new roads, airports and seaports cropping up at the vast Lekki peninsula, in Badagry and practically every conceivable part of the Lagos metropolis and suburban areas (Figure 3). Hence, the pressure on fishing sites for sand [10].

Among the various yardsticks for determining the quality of river's water for most aquatic habitat to thrive (dissolved oxygen, pH, water temperature, electrical conductivity, suspended solid among others), turbidity is a serious problem in sand dredging area. Turbidity refers to an optical property of liquids that measures the scattering and/or absorption of light due to material suspended in solution [11-14]. High turbidity is treated as an environmentally detrimental input. Suspended solids may affect biological resources in various ways Chansang, including physical harm to fish, interference with self-purification of water by diminishing light penetration and, hence, photosynthesis reactions [15]. Sublethal and lethal effects of turbidity have been noted for a number of organisms and include decreased disease resistance, hatching success, growth and egg development, as well as suffocation and death due to enhanced predation success [11,14,16].

From the foregoing, fishing activity is affected by sand dredging. Ashraf et al. affirmed the negative effect of sand mining on the fishing

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Figure 1: A dredger in action at Epe, Lagos State.

Figure 2: A nearby dump site for dredged sand at Bayeku.

environment which by extension affects fishing activity [17]. Increasing demand for sand for construction purpose and the supply gap created by dredging on land has made river/sea sand dredging a major threat to aquatic habitat and fishing as a means of livelihood (Figure 4). The ability of artisanal fishing to play its crucial role of a food supplier, employment provider and income earner in the Nigerian economy depends on the adoption of appropriate management strategies that will ensure sustainability of the sub-sector in the face of increasing human population in fishing communities and other human activities; such as sand dredging which is now common in most fishing communities [18].

Several studies on cost and returns of artisanal fishermen (Anyanwu et al. [19]; Inoni and Oyaide, [18]; Onemolease and Oriakhi, [20]; Adewumi et al. [21]; Suleiman and Tosan, [22]; Mafimisebi et al. [23]) exist in literature; however, very few of these studies consider the effect of prevailing environmental conditions in the fishing environ; such as the effect of river sand dredging on the cost and returns of artisanal fishermen. Moreover, the cost implications of the distance covered and the hours spent by fishermen during fishing are often excluded in the most studies (Figure 5). The study sets out to address these, fill the literature gap by comparing the cost and returns of fishermen in sand dredging and non-dredging areas as well as to draw comparison with fishermen in non-dredging areas based on socioeconomic characteristics. To achieve this, the following research questions are raised: Is there significant difference in the average quantity of fish caught per labour-hour in sand dredging and non-dredging areas? Is there significant difference in the average household size of fishermen in sand dredging and non-dredging areas? What is the average total cost incurred per day by fishermen in sand dredging and non-dredging areas? What is the breakdown of cost items in sand dredging and non-dredging areas? What is the average per capita gross profit of fishermen in dredging and non-dredging areas?

River sand dredging

River sand Dredging is an excavation activity or operation usually carried out at least partly underwater in shallow seas or fresh water with the purpose of gathering up bottom sediments and disposing of them at different location [24,25]. Dredger is any device, machine, or vessel that is used to excavate and remove material from the bottom of a body of water [26]. The process of dredging creates spoils (excess material), which are carried away from the dredged area (Figure 6). Dredging can produce material for land reclamation or other purposes (usually construction-related), and also has historically played a significant role in gold mining [27].

Effects of sand dredging on aquatic habitat include habitat removal, removal of existing benthic populations, burial of nearby

Figure 3: Sorting of fish at Elubo, Epe.

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Figure 4: Typical fishing shed with dredging activity at the background at Baayeku.

Figure 5: A high turbid water at one of the dredging sites.

benthos due to turbidity or side casting activities, increased turbidity, and alterations to current patterns, sediment, water quality, salinity and tidal flushing (Figure 7). Direct dredging effects to fish may include capture and killing by dredge equipment, disruption of normal foraging or spawning behaviours, and gill injury from exposure to local increases in turbidity [28].

Based on the basic means of moving material, USEPA and USACE classified sand dredging into two, namely, hydraulic and mechanical dredging [29]. Hydraulic dredges remove and transport sediment in liquid slurry form. They are usually barge mounted and carry diesel or electric-powered centrifugal pumps with discharge pipes ranging from 6 to 48 inches in diameter. The pump produces a vacuum on its intake side, and atmospheric pressure forces water and sediments through the suction pipe (Figure 8). The slurry is transported by pipeline to a disposal area.

Mechanical dredges remove bottom sediment through the direct application of mechanical force to dislodge and excavate the material at almost in situ densities. Backhoe, bucket ladder, bucket wheel, and dipper dredges are types of mechanical dredges. Sediments excavated with a mechanical dredge are generally placed into a barge or scow for transportation to the disposal site. Hydraulic dredging is the most common among the large scale sand dredging firms while there are small scale sand dredgers that make use of locally made boats and basket in the study area.

Theoretical Framework and Literature Review

The study is based on the economic theory of a common-property resource. Economic theory of common-property resource states that the ownership of resource is based on descent rights and age-long socio-cultural values which confer equal rights on the member. The owners demonstrate strict compliance with the inheritance rules and practices, maintain exclusive rights over the resources and uphold the principle of inalienability so as to ensure ease of transferability to their heirs [30]. Common-property natural resources are free goods for the individuals in the community and scarce goods for society [31]. Regardless of who is governing a common-property resource, it is subject to basic concepts of production theory. Aside being subject to law of diminishing returns, other human activities such as, over-exploitation, sand dredging may hasten the rate in which fish production reaches third stage of production (fish output decreasing at decreasing rate) (Figure 9a).

In any production activities including pseudo production taking place in artisanal fishing, costs are incurred. These costs can be broadly divided into fixed and variable costs. Fixed costs are depreciation costs on fixed items such as canoe, paddle, net, basket, trap, rope among others. Variable costs are costs that do vary with output, and they are also called direct costs. Since artisanal fishermen are not involved in

Figure 6: Local sand miners Majidun beach, Ikorodu.

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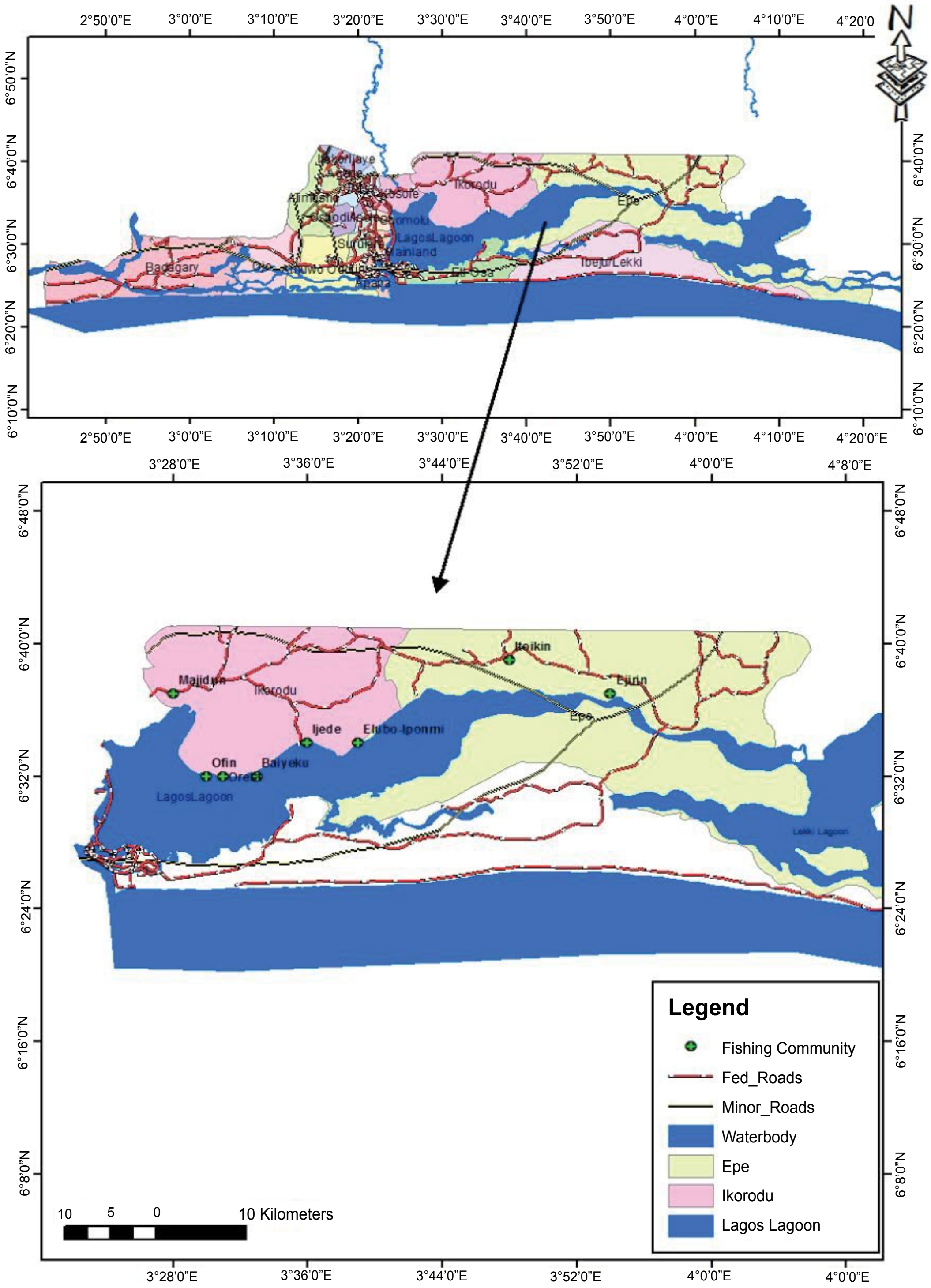

Figure 7: Map of Ikorodu and Epe in Lagos state.

real fish production, they often incurred very small or no variable costs (Figure 9b). The common variable item among artisanal fishermen is bait. The addition of variable costs and fixed costs give the total cost incurred by artisanal fisherman.

Total revenue is unit price (per kg) times the quantity of fish caught and sold (kg) by artisanal fisherman. The difference between total revenue and total cost give gross profit or loss. Profit is recorded when total revenue is greater than total cost while loss is recorded when total revenue is less than total cost incurred. A fisherman breaks even when his total revenue is equal to total cost. For the well-being of artisanal fishing households, the need to make profit that reflects the existing economic reality in terms of value of money is imperative.

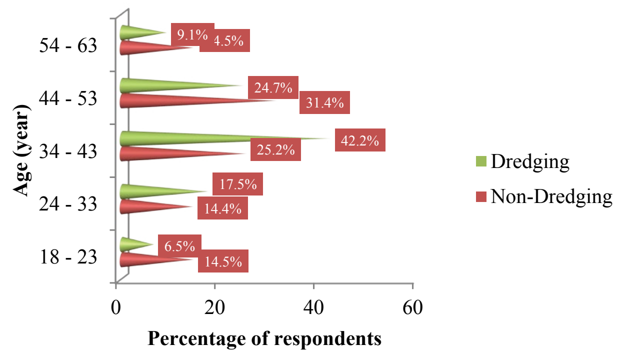

Figure 8: Age distribution of respondents.

(a) (b)

Figure 9: (a) It shows fisherman and his children looking disappointed at the sizes of fish caught at Majidun. (b) It shows the weighing of the fish caught.

Various studies have been carried out on cost and returns of artisanal fishermen. However, none of these studies considered the environmental situation in relation to the costs and revenue accrued to fishermen in their respective study area. Cost and revenue obtained from these studies are often generalised regardless of the environmental situation (example is sand dredging) that is taking place. Unongo revealed that the average cost incurred on fixed items by fishermen in his study area was higher than the average variable cost [32]. The breakdown showed that fixed items accounted for 56.77% of the total cost incurred per year. This may be attributed to the fact that most artisanal fishermen use less of variable items since they are not involved in the rearing fish. The study showed that a fisherman made an average gross profit of N18,413.68 per year. The value is far less than (N49,377.18) what Gbigbi and Taiwo reported in a similar study. However, the differences in the study area may be attributed to the variation [33]. They opined that artisanal fishing is profitable in the study area (Niger-Delta). Suleiman and Tosan submitted that although artisanal fishing is profitable, the return on investment is low thereby leaving the operators vulnerable to loss in case of downward shift in market price of fish [22].

Moreover, in a study on the structure and profitability differentials among fishermen in Kwara state, Nigeria by Oladimeji et al. they reasoned that the gross margin accrued to fishermen is not only dependent on the kilogram of fish caught and price per kilogram, but also dependent on the variable costs [34]. Therefore, the combined effects of low yield and high cost of production, particularly of variable costs components, are implicated for the rather low net margin per kilogramme. The implications of the obtained net margin/kg however, are that for every kilogramme of fish caught, the fisherman earns a gross margin of N35.53 for motorised operators and N29.30 for non-motorised. The variation in this result and that of Inoni and Oyaide that reported average net margin/kg of N80.26 may be attributed to the different agro ecological zone used as study area. Although the net margin per kilogramme revealed the level of performance of fishermen but such results may be deceptive since the cost incurred on fixed items are not included.

Generally, the reported profit recorded by artisanal fishermen contradicts the high level of poverty in fishing communities [35]. This may however be attributed to the fact that the profits do not reflect the existing economic situation.

Methodology

The study utilized primary and secondary data. The primary data were collected in July 2014 from two Local Government Areas (LGA) in Lagos state known for artisanal fishing and sand dredging; namely Ikorodu and Epe. The two LGAs have rivers that empty into Lagos lagoon. The map of the two contiguous LGAs is shown in Figure 7. The primary data were collected using two-stage sampling technique (purposive and simple random). The fishing communities sampled in the two LGAs were Oreta, Majidun, Itoikin, Ofin, Bayeku, Ijede, Ejinrin, Elubo and Iponmi via Agura Gberigbe. A total of 450 questionnaires that addressed the objective of the study were administered while 332 were returned (see the Appendix for the detail of how the study arrived at the sample size of 450). After processing, 314 of the questionnaires were appropriate for the analysis. Data collected from fishermen in sand dredging and non-dredging areas include socio-economic characteristics, the average quantity of fish caught per day (kg), price per kilogramme of fish, average hours spent per fishing trip as well as the distance covered (km). Other data collected are the various cost items used for fishing (boat, net, rope, basket, paddle, and other locally made traps used).

Secondary data on the water quality of the fishing communities sampled were sourced from Odunaike et al. [36] Nkwoji et al. [37] and Idowu et al. [38]

Cost and return analysis

Various cost items (variable and fixed) incurred by respondents in the two areas (dredging and non-dredging) were identified. The contribution of fixed items to fishing activity per day was determined using straight line method of depreciation (see Equation 1). Gross profit of fishermen in dredging and non-dredging areas was estimated using equation (2). The costs of the following fixed items, namely; locally made canoe, paddle, net, basket, trap and rope were considered for each fisherman in the dredging and non-dredging areas. Bait and the distance covered were the variable items used by the artisanal fishermen in the study area.

$$\text{Depreciation Value (N)} = \frac{\text{Cost of the item (N)}}{\text{Economic life span (year)}} \quad (1)$$

$$\text{Average Gross Profit (AGP)} = \text{TR} - \text{TC} \quad (2)$$

Where:

AGP=Average Gross Profit (N)

TR=Total Revenue (N)

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TC=Total Cost (N)

Total Revenue (TR) = PQ (3)

Total Cost (TC)=Total Fixed Cost + Total Variable Cost (4)

Where:

P=price (N) per kg of fish

Q=the quantity of fish sold

Results and Discussion

The result in Table 1 revealed that 91.1% of the respondents were male. This confirms earlier studies that artisanal fishing is a male dominated economic activity [39,40]. Women are more involved in fish marketing and processing [23]. Most respondents in the non-dredging (31.4%) and dredging (42.2%) sites are within the age bracket of 44-53 and 34-43 years respectively (Figure 8). This indicates that fishermen in sand dredging areas are younger compared to non-dredging area. This may be attributed to the fishermen in non-dredging areas tendency to stay in the business for longer period because of little or no disturbance of the aquatic environment due to the absence of sand dredgers.

Moreover, the result shows that there is no significant difference in the average ages of fishermen in non-dredging and dredging areas ($p>0.05$). Also, the result revealed that 70.6% of the total respondents are married while 64.2% and 77.3% are married among fishermen in non-dredging and dredging sites respectively. From the result, there are more married fishermen in the dredging areas. Moreover, more than half of the respondents can read and write in the two areas. However, the level of literacy is marginally higher in the sand dredging areas (71%) compared with non-dredging areas (69%).

The average household size among the all respondents is 7.9 while the values are 8.6 and 7.2 for respondents in non-dredging and dredging areas respectively. There is also statistical significant difference in the average household size between respondents in non-dredging and dredging areas ($p<0.01$) (Table 1). The average household sizes in the two locations are more than the national average household size (5.2) and the average household size of Lagos state (3.8) [41]. This confirms high population among the fishing communities (SFLP) in the study area which encourages overexploitation of fish in order to meet up with the food need of the household [4]. Arthur opined that higher family size brings about pressure on the already inadequate forms of livelihood offered by the environment [42]. The high household size is typical of peasant farmers generally [43,44]. Peasant farmers believe that large family assist in farming as shown in this result where 95.8% of the fishermen relied on family labour. Table 1 shows that for all the respondents, the average quantity of fish caught per labour hour is 8.05 kg with the standard deviation of approximately 2.9 kg. Moreover, the quantity of fish caught per labour hour in the non-dredging area (7.3 kg) is significantly ($p<0.01$) greater than that of the dredging area (5.3 kg). This may be attributed to the long distance travelled by fishermen whose communities are in the sand dredging areas. The quantity of fish caught per labour hour shows that fishermen in non-dredging areas have higher productivity and are more labour-hour efficient. According to fishermen move in fulfilment of their occupation, they move in search of fish as dictated by the type of fish required and the movement of the tide which may be caused by sand dredging. The average distance covered by fishermen in the sand dredging area is significantly greater than that of fishermen in non-dredging area (Table 1). Travelling longer distance to places where the effect of dredging is minimal may be their copy strategy since their livelihood depends on the fish caught per day. Also, the result shows that apart from travelling longer distance, fishermen whose community is located in the vicinity of sand dredging spent longer hours fishing ($p<0.01$). The significant difference in the average water turbidity in sand dredging and non-dredging areas confirms that sand dredging has negative effects on fishing activities. This finding corroborates the submissions of studies Moore [11] Chansang [15] Simenstad [16] Cone [14] that high turbidity causes physical harm to fish, decreases disease resistance, hatching success, growth and egg development. It interferes with self-purification of water by diminishing light penetration and, hence, photosynthesis reactions.

Furthermore, Table 2 shows the breakdown of the various costs incurred per day as well as the average daily revenue of fishermen in the study area. The table reveals that fishermen in the dredging area incurred higher cost per day. This may be attributed to cost incurred on long distance travelled to catch fish in order to avoid dredging area. The fixed inputs used by the fishermen were unmotorized canoe, paddle, net, basket, knife and plastic bowls. The contribution of each of these items to the fish caught per day was determined using straight line method of depreciation and the number of days each fisherman work per week. The result show that respondents (fishermen) at non-dredging areas spent on average N281.90 on fixed capital per day while respondents having their community in the vicinity of sand dredging areas spent N257.60 per day. Fishermen in the non-dredging areas incurred higher amount on fixed capital because they spent more on local traps that are set in their surroundings ($p<0.01$). These (traps) are checked frequently unlike the fishermen that travel longer distance from their base. Also, fishermen in the no-dredging areas invest more in new unmotorized boats.

Moreover, bait and the distance travelled were the variable items of the fishermen in the study area. This is common in environment where common property theory is in place. Like forest product gatherers, artisanal fishermen continuously exploit the natural resources without adding anything in return. Increase in population increases the pressure on the exploitation of natural resources. According to human population density increases, presence of large-bodied fishes

Output and Input	Total 313		Non-dredging Site (161)		Dredging site (152)		Equalities
	Mean	Sd	Mean	sd	Mean	sd	p-value
Quantity caught per labour hr	8.1	2.9	7.3	2.3	5.3	2.1	0
Labour – hour (hr)	4.2	2.4	2.1	1.1	6.4	2	0
Capital (N)	255.2	152.4	281.9	174.4	227.6	120.3	0.001
Bait (N)	122.2	37.5	123.1	35.3	121.4	40	0.683
Water Turbidity (NTU)	79.9	77.8	23.3	17.1	139.9	71.7	0
Household characteristics							
Experience in fishing (year)	16.5	6.7	16.5	7.1	16.6	6.2	0.888
Age (year)	43.9	11.5	44.3	12.6	43.6	10.1	0.597
Marital status	0.7	0.5	0.6	0.5	0.8	0.4	0.011
Household size	7.9	3.1	8.6	3	7.2	3.1	0
Educational status	0.7	0.5	0.69	0.46	0.71	0.46	0.759
Other economic activities	0.45	0.5	0.5	0.5	0.4	0.5	0.057
Area characteristics							
Distance covered (km)	6.8	6.7	2.4	2.3	11.4	6.7	0

Note: For all tests of means, the null hypothesis is that the no significant difference in the variables. The confidence level chosen is 5%. Quantity caught per labour hour is in kilogramme.
NTU means Nephelometric Turbidity Units

Table 1: Descriptive statistics by fishing site.

declines, and fish communities become dominated by a few smaller-bodied species. Figures 9a and 9b show the small-size fish caught [45-47]. The small sizes of fish may be attributed to over exploitation occasioned by large household size among fishermen. Same reason may be adduced for fishermen engaging in other economic activities such as barbing, vulcanizing, tailoring, bricklaying, security among others to complement their little income from fishing. From the result, 50.3% and 39.6% of fishermen in non-dredging and dredging areas respectively were engaging in other economic activities.

Table 2 shows the breakdown of costs and returns of fishermen in the study area. The table reveals that fishermen in the dredging area incurred higher cost per day. This may be attributed to cost incurred on long distance travelled to catch fish in order to avoid dredging area. Fishermen in the non-dredging area incurred more cost on canoe, trap and net. Specifically, the higher cost on locally made trap may be due to their closeness to the fishing water which gave them opportunity to inspect the trap easily. This is unlike fishermen residing in the sand dredging areas that have to travel a long distance to fish. However, the fishermen in the sand dredging area spent more on miscellaneous items (knife, plastic bowl among others).

However, the average total cost per day for fishermen in the sand dredging area is higher than that of non-dredging area. However, the average daily revenue from fish is higher among fishermen in the non-dredging areas (Table 2). This may be attributed to extra income realised from other economic activities engaged in by fishermen in non-dredging areas. Also, the table shows that 52.5% and 58.4% of the average total cost incurred per day by artisanal fishermen in dredging and non-dredging areas respectively were average total fixed costs incurred per day. This result on the non-dredging areas is in agreement with Unongo [32].

Items	Average amount (N)		
Fixed cost per day	**Total Sample Site (313)**	**Non-dredging site (161)**	**Dredging site (152)**
Canoe	152.34	156.46	148.22
Paddle	5.21	5.52	4.84
Net	81.48	90.32	72.02
Basket	4.57	4.21	4.85
Trap	5.68	7.26	4.1
Rope	6.68	6.93	6.58
Miscellaneous (knife, plastic bowl/bucket etc)	19.11	11.2	16.99
Average total fixed cost	275.07	281.9	257.6
Variable cost per day			
Cost of distance covered	65.96	23.28	110.58
Bait	122.24	123.24	122.81
Average total variable cost/day	188.2	146.52	233.39
Average total cost per day	463.27	482.42	490.99
Average revenue per day from fish	4,309.94	3,952.88	4,695.08
Revenue accruable for extra hours (other economic activities)	660	1290	-
Average total revenue per day	4969.94	5242.88	4695.08
Average gross profit per day	4,506.67	4,760.46	4,204.09
Average Household size	7.9	8.6	7.2
Average per capita gross profit	570.46	553.54	583.9
Source: Author's computation			

Table 2: Breakdown of costs and return for fishermen.

However, fishermen in non-dredging areas have higher returns from other economic activities. From Table 2, the average gross profit per day is higher among the fishermen in the non–dredging areas. Furthermore, the average per capita gross profit is higher among fishermen in the dredging areas due to smaller average household size among fishermen in the dredging areas compared with non-dredging areas [48-50]. While overexploitation (large household size) alone may be the reason for smaller per capita gross profit among fishing households in the non-dredging area, it is the combination of overexploitation and dredging activities in the sand dredging area.

Overexploitation is the result of increasing human population encouraged by common property theory in the study area. The average per capita gross profit is far below the national per capita income of N1,339.72 per day [50]. Hence, the need for fishermen to engage in the rearing of fish and other environmental suitable economic activities in their respective communities to complement their present income what they are getting presently.

Conclusion and Recommendation

The study examined the economic burden of sand dredging on artisanal fishing in Lagos state. The study revealed that the fishing communities are exploiting the shortcomings of common property theory. Most especially, the large population which encourages over exploitation of fish as confirmed by the sizes of fish caught. The study also showed that 45.2% of the fishermen claimed that dredging has been going on in their communities in the last 6-10 years. The negative effect of sand dredging captured by water turbidity was more pronounced in the sand dredging fishing communities. This manifested through reduced quantity of fish caught per labour hour among fishermen in sand dredging areas. Also, fishermen in the non-dredging area incurred less cost and higher gross profit. The finding attributed the low per capita gross profit (lower than national per capita income) among the fishermen in non-dredging areas to mainly overexploitation (high household size) while sand dredging and overexploitation were the reasons for smaller per capita gross profit among fishermen in sand dredging areas. The study affirmed that fishermen residing in the dredging vicinity adopted moving far away from dredging site in order to fish as their major coping strategy. Apart from been stressful, it may hasten the depreciation fixed inputs, such as canoe and paddle. However, while this study has been able to capture the effect of one environmental factor (water turbidity) through sand dredging; there are other environmental factors affecting artisanal fishing but the study was unable to capture due to data limitations.

In order to bring about harmonisation between sustainability of natural resources and human survival, the need for the fishermen to diversify their source of income in order to bring about sustainable improvement in their well-being as well as reducing pressure on aquatic animals. It is also pertinent for government to restrict the activities of sand dredgers to non-fishing community environment.

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References

1. Federal Department of Fisheries (2005) Fisheries Statistics of Nigeria, FDF Publication, Abuja, Nigeria.
2. Faturoti O (2010). Nigeria: Fisheries contribute billion to economy. 25th Annual Conf. Fish. Soc. Nigeria.
3. Bada AS (2005) Strategies for Bridging the Supply-Demand Gap in Fish

Production in Nigeria. Proceedings of the 19th Annual Conference of the Farm Management Association of Nigeria. pp: 329-337.

4. Sustainable Fisheries Livelihoods Programme (SFLP) (2002) Committee on Fisheries Research Joint Working Party on Poverty in Small-Scale Fisheries: Promoting the Contribution of the Sustainable Livelihoods Approach and the Code of Conduct for Responsible Fisheries in Poverty alleviation, Rome. Issue 678 of FAO fisheries report, Food and Agriculture Organization.
5. Ask. com (2014) What is sand dredging? Available on www.ask.com
6. Whitehead GJ (2007) Land and environment: sand mining.
7. Kondolf GM (1997) Hungry water: effects of dams and gravel mining on river channels. Environmental Management 21: 533-551.
8. Meador MR, Layher AO (1998) Instream sand and gravel mining: environmental issues and regulatory process in the United States. Fisheries 23: 6-13.
9. Kim YT, Kim HJ, Lee GH (2008) Mechanical behaviour of lightweight soil reinforce with waste fishing net. Geotextiles and Geomembranes 26: 512-518.
10. Drill D, Haul (2009) The Changing Dredging Scene.
11. Moore PG (1977) Inorganic particulate suspensions in the sea and their effects on marine animals. Oceanography and Marine Biology Annual Review.15: 225-363.
12. Wilber CG (1983) Turbidity in the aquatic environment: An environmental factor in fresh and oceanic waters. Charles Thomas Publications, Springfield, IL.
13. Sigler JW (1990) Effects of chronic turbidity on anadromous salmonids: Recent studies and assessment techniques perspectives. In: Simenstad CA (ed.) Effects of dredging on anadromous Pacific Coast fishes: workshop proceedings. University of Washington Sea Grant Program, Seattle, Washington. pp: 26-37.
14. Cone LD (1995) A review of the potential impacts of mechanical harvesting on subtidal and intertidal shellfish resources. Marine Resources Research Institute, SC Department of Natural Resources, Charleston, SC.
15. Chansang H (1988) Coastal Tin Mining and Marine Pollution in Thailand. Ambio 17: 223-228.
16. Simenstad CA (1990) Effects of dredging on anadromous Pacific coast fishes: workshop proceedings. University of Washington Sea Grant Program, Seattle, Washington.
17. Ashraf MA, Maah MJ, Wajid AIY, Karamat M (2011) Sand mining effects, causes and concerns: A case study from Bestari Jaya, Selangor, Peninsular Malaysia. Scientific Research and Essays. 6: 1216-1231.
18. Inoni OE, Oyaide WJ (2007) Socio-Economic Analysis of Artisanal Fishing in the South Agro-Ecological Zone of Delta State, Nigeria. Agricultura Tropica et Subtropica. 40: 135.
19. Anyanwu DC, Mkpado M, Ohaka CC (2009) Economic analysis of artisanal fishing at River Niger. Journal of Tropical Agriculture, Food, Environment and Extension 8: 175-179.
20. Onemolease EA, Oriakhi HO (2011) Prospects and constraints of artisanal fishing in selected communities in Delta State, Nigeria. Advances in Applied Science Research 2: 55-61.
21. Adewumi MO, Ayinde OE, Adenuga AH, Zacchaeus ST (2012) The profitability analysis of artisanal fishing in Asa River of Kwara state Nigeria. International Journal of Development and Sustainability.1: 932-938.
22. Suleiman A, Tosan F (2014) Analysis of Costs and Returns of Artisanal Fish Marketing in Kebbi State, Nigeria. Journal of Rural Economics and Development 20: 21-29.
23. Mafimisebi TE, Ikuemonisan ES, Mafimisebi OE (2013) Comparative Profitability of Women Dominated Fish-Based Livelihood Activities in Southwest, Nigeria.
24. U.S. Environmental Protection Agency (1995) Sector notebook project: profile of the non-fuel, non-metal mining industry. EPA, Office of Compliance, Washington, D.C.
25. Wikipedia free encyclopedia (2014) Artisan fishing.
26. Mayer BV (2011) Dredgers and Dredging.
27. Wikipedia, the free encyclopedia (2014) Dredging.
28. Rivers and Coast (2010) Shallow Water Dredging. Centre for Coastal Resources Management. 5: 1-8.
29. U.S. Environmental Protection Agency and U.S. Army Corps of Engineers (1992) “Evaluating environmental effects of dredged material management alternatives - a technical framework”. University Press, Cambridge.
30. Olomola SA (1998) Sources and Resolution of Conflicts in Nigerian Artisanal Fisheries. Society and Natural Resources 11: 121-135.
31. Olomola AS (1993) The traditional approach towards sustainable management of common property fishery resources in Nigeria. Marine Anthropology Studies 6: 92-109.
32. Unongo T (2010) Economic Analysis of Artisanal Fishing Enterprises in Guma Local Government Area of Benue State, Nigeria. A M.Sc. Thesis, Department of Agricultural Economics. University of Nigeria, Nsukka.
33. Gbigbi MT, Osun T (2014) Technical efficiency and economic returns in artisanal fishery in the Niger-Delta, Nigeria. International Journal of Fisheries and Aquatic Studies 2: 184-188.
34. Oladimeji YU, Abdulsalam Z, Damisa MA (2013) Socio Economic Characteristics and Returns to Rural Artisanal Fishery Households in Asa and Patigi Local Government Areas of Kwara State, Nigeria. International Journal of Science and Nature 4: 445-455.
35. Ellis F (2000) The determinants of livelihoods diversification in developing countries. Journal of Agricultural Economics 51: 289-302.
36. Odunaike K, Laoye JA, Adeniyi TLP, Akinyemi LP, Adeyeloja A (2013) Physico-Chemical Characterization Of Water Samples at Egbin Thermal Station in Ijede and its Environs in Lagos State Of Nigeria. Journal of Environment and Earth Science.
37. Nkwoji JA, Onyema IC, Igbo JK (2010) Wet Season Spatial Occurrence of Phytoplankton and Zooplankton in Lagos Lagoon, Nigeria. Science World Journal.
38. Idowu ET, Amaeze NH, Adie PI, Otubanjo OA (2014) Heavy metal bioaccumulation and biomarkers of oxidative stress in the wild African tiger frog, Hoplobatrachus occipitalis. African Journal of Environmental Science and Technology 8: 6-15.
39. George F, Odulate D, Idowu A (2012) Climate change effects and adaptation strategies in a Nigerian coastal Agro-ecological zone. A paper presented at 2nd International Symposium on effects of Climate Change on the World’s Oceans, Yeosu, South Korea.
40. Simon AA, Kerere FO (2013) Assessment of the knowledge level of fishers and fish farmers in Lagos State, Nigeria. International Journal of Knowledge, Innovation and Entrepreneurship 1: 41-56.
41. National Bureau of Statistics (2012) Social Statistics in Nigeria.
42. Arthur JL (2007) Family Size and Quality Of Life Nexus- Case of the Sunyani Municipality, Ghana.
43. Bester BJ, Belete A, Kelembe SG (1998) Assessing Peasant Farmers’ Risk Attitudes and Factors that Influence Decisions on Risky Alternatives: A Case Study in the Border Region of South Africa. Agrekon.
44. Asogwa BC, Abu O, Ochoche GE (2014) Analysis of Peasant Farmers’ Access to Agricultural Credit in Benue State, Nigeria. British Journal of Economics, Management & Trade 4: 1525-1543.
45. Committee on Ecosystem Effects of Fishing (2002) Effects of Trawling and Dredging on Seafloor Habitat.
46. Ele IE, Osadebamwen AO, Nkang MO (2015) Socioeconomics, costs and returns and technical efficiency of Bonga fishermen in the Lower Cross River Basin, Nigeria. Global Business and Economics Research Journal.4: 1-20.
47. Fish for All Summit (2005) Presentation of Nigeria’s Fisheries Resources, Abuja, Nigeria. Pp: 22-25.
48. Food and Agriculture Organisation (2008) Marine Fishery Resources of Nigeria: A review of exploited fish stocks.
49. U.S. Army Corps of Engineers (2004) Framework for Assessment of Potential Effects of Dredging on Sensitive Fish Species in San Francisco Bay. Final Report.
50. The Guardian Global Development Professional Network (2014) Nigeria becomes Africa’s largest economy.