

Perspectives of Fishers on the Incident of Fish Kills in Coastal Waters in Rivers State, Nigeria

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ABSTRACT This study was conducted to assess fishermen's perspectives on the massive fish kill incident in coastal waters in Rivers State, Nigeria. Primary data were collected using questionnaires from 101 randomly selected fishermen and the data were evaluated using descriptive statistics. The results showed that fishing was the main occupation of the respondents and the interviewed fishermen have fishing experience in the region studied and knowledge of their fishery. The results showed that 53.3 percent of fishermen attributed the strange phenomenon to pollution, while 19.8 percent of fishermen cited infection and disease as the cause of the fish kills. The majority of respondents (94%) reported that croaker fish species were particularly affected in the study area. Other observations include fish swimming on the surface or jumping onto shore and affected fish washing up on shore. The unusual appearances of the dead fish commonly reported by respondents were as follows: fin rot, open mouth, disease spots and deep blue gills. About half of the respondents (50.5%) gave a range of 1,000 - 5000 dead fish and a size class of the dead fish of more than 30 cm. Most respondents (79.2%) indicated that the government has not taken any action. Few of those surveyed reported government action on sea clean-up exercises to remove dead fish, end oil spillage and bunkering as measures put in place by the government. The study recommended partnerships between the government and fishermen and fishermen's groups as stakeholders are required to address the concerns about marine waters.

Keywords: Coastal waters; Fishers; Mass fish mortality; Nigeria

INTRODUCTION

Fish kills are a common phenomenon and are generally defined as localized mass fish die-offs that can occur in marine, estuarine, or freshwaters (Meyer & Barclay, 1990). and had been attributed to diseases, parasites, changes in water physicochemical parameters caused by natural phenomena, or anthropogenic activities (i.e., extreme temperature values, acidification, eutrophication, pollution, droughts, harmful cyanobacterial blooms) and more commonly to the synergistic effect of two or more causal factors (Glibert *et al.*, 2002). The mass fish deaths indicate problems in their environment which could affect other animals and plants as well as human health.

In late March 2020, a massive fish kill event occurred within 2 nautical miles in some coastal waters of Nigeria, particularly in the Niger Delta region, which has suffered widespread oil spills, gas flaring and associated hydrocarbon pollution for the past six decades and coincided with the outbreak of the coronavirus pandemic, a public health emergency of international concern. Although several fish kills have occurred in the Niger Delta region, particularly smaller and localized fish kills associated with oil exploration activities, the current fish kill phenomenon was unique in that it occurred simultaneously along the Atlantic coast in the subsequent Bayelsa, Rivers, and Delta states of the Federal Republic Nigeria and lasted for a few days before returning to normal conditions and no deaths were observed.

The fishes of the family Sciaenidae, commonly called "drums" or croakers, were only affected across all the observed affected areas. Croakers, or sciaenids (family

Sciaenidae), are one of the major coastal fishery resources of tropical and temperate waters (Litig *et al.*, 2022). With high commercial value, these species play an important role in providing food and income for the fishers in coastal communities and due to its high demand in nation and international market, continuous fishing pressure which has increased to levels that cannot be sustained resulting in the croakers are showing signs of being overfished. This situation is exacerbated further by the recent mass fish mortality in this region.

Understanding fishers' perceptions of massive fish kills is vital for future management of the incident. Involving members of the fisher folk in reporting fish kills has made a valuable contribution to the investigation process because (as in the current case) they are usually the first to notice incidents, and because it makes them more accountable for their local coastal areas (Alosairi *et al.*, 2021). Silver & Campbell (2005) strengthen this argument by stating the importance of fishers being key marine co-operators as they are the ones who often explore and exploit marine resources. In this context, this study compiles information on the perspectives of fishers on the incident of massive fish kills in coastal waters in Rivers State, Nigeria.

MATERIALS AND METHODS

Rivers State is one of the 36 states of Nigeria, bordered on the south by the Atlantic Ocean and on the north by Imo, Abia, and Anambra States. It is situated on the map of Nigeria at latitudes 4° 43' 34.11' North and longitude 6° 55' 15.11' East in the Niger Delta area of the South-South geopolitical zone. This study was conducted in a

Table 1 also shows that the majority (59.4%) of the respondents had a secondary school education, 32.7 percent attended primary school, and only 7.9 percent had no formal education. This implies that the literacy level of fishers in Rivers State is high, and this will definitely influence the adoption of innovation in fishing. Most of the respondents (54.9%) have been living in the study area for more than twenty years, and about 64.4 percent of the respondents have been fishing in the study area for more than 20 years. The findings indicated that fishing is the primary occupation of the respondents; however, they also pursue alternative livelihoods for increasing income. This is in line with the observation that local people have free access to fisheries in that they decide how fishing takes place and the intensity of the activities that are involved (Flateen, 2010). Most (84.2%) of them were full time fishermen. According to FAO's Coordinating Working Party on Fishery Statistics (1999), a full-time fisher is one who receives or spends at least 90% of their livelihood or 90% of their work time within that occupation, while part-time fishers are those who receive or spend at least 30%, but less than 90%, of their livelihood or work time in the fishing occupation.

Information on the occurrence of massive fish kills

Table 2. Information on the occurrence of massive fish kills.

Massive fish kills	Frequency	Percentage
<i>Location where the mass fish kills occurred</i>		
High sea	87	86.1
Coastal waters	14	13.9
<i>Time of day when the Mass fish kills occurred</i>		
Morning	76	75.2
Afternoon	12	11.89
Evening	1	0.09
Over night	11	10.9
<i>Causes of fish kills by the fishers</i>		
Pollution	54	53.3
Infections and diseases	20	19.8
Unknown	27	26.7

Table 2 shows the information given by the fishers on the occurrence of mass fish kills. The majority (86.7%) of the fishers reported that the incident of massive fish kills occurred at sea, and only 13.9 percent of the respondents claimed that the fish kills occurred in coastal waters. Most of the fishermen (75.2%) claimed that the fish kills occurred in the morning. Fish kills can occur at any time of the day and in any month of the year. Further analysis in Table 2 reveals that 53.3 percent of the fishermen attributed the strange phenomenon to pollution. According to La & Cooke (2011) Agricultural runoffs, biotoxins and chemical pollutants are among the most common primary causal factors of mass fish kills. In the Niger Delta region, fish kills have been observed many times in marine waters and transitional water systems as a result of oil exploration and spillage and its many problems. For example, oil exploitation has increased the rate of environmental degradation and has perpetuated food

insecurity as a result of death of fish and crops as well as loss of farm lands and viable rivers for fishing activities leading to loss of livelihood (Elum et al., 2006). However, fish kills are generally associated with changes in water quality, pollution, infection, being directly associated with human activities, or a combination of these causes. About 19.8 percent of the fishers reported infections and diseases as the cause of the fish kills.

Observations on the weather and water quality by the fishers prior to the mass fish kills

The survey revealed that about 78.2% of the respondents reported heavy rainfall prior the massive fish mortalities and most (75.2%) of the respondents reported that the colour of marine waters to be normal. Also, 85.4 percent of the respondents claimed that the odour of the water was normal.

Table 3. Observations on the weather and water quality by the fishers prior to the mass fish kills.

Observations	Frequency	Percentage
<i>Weather</i>		
Heavy rain	79	78.2
Cloudy	11	10.9
High wind	11	10.9
<i>Physical characteristic of marine water</i>		
<i>Change in colour of the water</i>		
Normal	76	75.2
Brownish	9	8.9
Milky	8	8.0
Blackish	8	8.0
<i>Change in odour of the water</i>		
Normal	86	85.4
Offence odour	15	14.6

Observations on affected or distressed fish species

Data in Table 4 reveal that the majority of the respondents (97%) reported that croaker fish species were mostly affected in the study area. This could be attributed to the fact that croakers form large aggregations for spawning, feeding, and over-wintering, which makes them vulnerable to overfishing (de Mitcheson & Liu, 2008) and other anthropogenic changes. Human activities have brought some changes to the ecological environment, significantly reducing fishery resources (You et al., 2016).

A fish kill caused by disease will typically affect only one or two closely related species, occur over a period of days or weeks, and include some individuals who are only mildly affected or not affected at all. Species-specific mass fish kills (in multi-species ecosystems) are mainly caused by a single factor (i.e., a disease), which, in most cases, can easily be identified (Glibert et al., 2002). The unusual appearances on the dead fish commonly reported by respondents were as follows: fin rots (33.6%), mouths agape (29.7%), disease spots (27.7%), and deep blue gills (5.5%). According to Austin (1999), alleged pollution-related diseases include epidermal papillomas, fin/tail rot, gill disease, hyperplasia, liver damage, neoplasia, and ulceration. Almost all of the respondents (93.1%) reported lesions on the bodies of affected fish species.

Table 4. Observations on affected or distressed fish species.

Fish species affected	Local name	Frequency	Percentage
<i>Affected fish</i>			
Croaker fish species	Broken marriage	98	97.0
Other fish species		3	3.0
<i>Unusual appearance on the dead fish</i>			
Deep bluish gills		5	5.5
Curved spines		3	3.0
Disease spots		28	27.7
Flared gills		1	1.0
Open mouth (mouths agape)		30	29.7
Fin rot		34	33.6
<i>Obvious lesions on their body</i>			
Yes		94	93.1
No		7	6.9
<i>Grey/white fungal growth on the dead fish</i>			
Yes		63	62.3
No		30	29.7
No comment		8	7.9
<i>Fish observed swimming at the surface or jumping onto the bank</i>			
Yes		83	82.0
No		18	17.8
<i>Kill is confined to a relatively small section of water way</i>			
Yes		22	21.8
No		79	78.2
<i>Fish are washed up along the shoreline</i>			
Yes		100	99.0
No		1	1.0

Also, about 62.3 percent claimed that they saw grey/white fungal growth on the dead fish. The obvious abnormalities signs on the affected fish species indicate that disease could be the cause of massive fish kills. Other observations reported by the respondents include fish swimming at the surface or jumping onto the bank; fish kills confined to a relatively small section of waterway; and affected fish washed up along the shoreline, accounting for 82 percent, 78.2 percent, and 99 percent, respectively. All these observations are signs of stress and disease in fish.

Estimated number and size class of dead fish

Table 5 below shows the estimated number and size class of dead fish. About half of the respondents (50.5%) reported a range of 1000-5000 dead fish, and 44.5 percent of the respondents reported over 5000 dead fish, while the remaining 27.7 percent of the fishers reported the size of the dead fish to be between 1000 and 5000. Because of the wide dispersal of dead fish in the area and the patchy accumulation of dead fish, it was not possible to determine the quantity of dead fish in the area. The mass fish deaths indicate problems in their environment, which could affect other animals and plants as well as human health (Alosairi et al., 2021). Most of the respondents reported the size class of the death fish to be above 30 cm. Loss of adult fish can have a long-term impact on

a fishery's success because the following year's spawning stock is lost, and the population can take years to recover (Alosairi et al., 2021).

Table 5. Estimated number and size class of dead fish.

Number of dead fish	Frequency	Percentage
<1000	5	5
1000-5000	51	50.5
>5000	45	44.5
<i>Size(s) of dead fish</i>		
20-30 cm	28	27.7
>30 cm	73	72.3

Frequency of occurrence of fish kills in the study area

Table 6. Frequency of occurrence of fish kills in the study area per year.

Occurrence	Frequency	Percentage
Once	83	82.2
None	16	15.8
Numerous	2	1.98
Total	101	100

Table 6 reveals the frequency of occurrences of fish kills in the area. Most of the respondents reported once, and

about 15.8 percent reported none. After a first occurrence, mass fish kills tend to reoccur (Thronson & Quigg, 2008). Therefore, there is a need to establish and enhance monitoring programs to collect baseline data in the affected areas.

Table 7. Activities provided by the government to stop fish kills.

Government intervention	Frequency	Percentage
None	80	79.2
End to oil spillage	3	3
End to oil bunkering	2	2
Sea-clean up exercise to remove dead fishes	16	15.8

Table 7 reveals the major measures taken by the government to stop the mass fish kills in the study area. Most of the respondents (79.2%) reported that the government has not put any measures in place. Only a few of the respondents reported sea-clean up exercises to remove dead fish and end oil spillage and bunkering as measures put in place by the government. This indicates that the government has not been involved in the activities of fishermen. Filling one of the gaps within fisheries management is by understanding the response of fishers to management measures (Zacharias, 2014). By involving fishermen in resource management, we can facilitate the development of conservation strategies. The failure of some government-based initiatives (Castilla & Gelcich, 2007) highlights the need to test more participatory alternatives in fisheries (e.g., real co-management and community-based management) (Nasuchon & Charles, 2010). As a result, partnerships between the government and fishermen and fishermen's groups as stakeholders are required to address the concerns about marine waters.

CONCLUSION

Massive fish kills have occurred in coastal waters in Rivers State, Nigeria. The majority of respondents reported that croaker fish species were mainly affected in the study area. Unusual appearances of affected dead fish include fin rot, open mouth, disease spots, and deep blue gills. In addition, the fishermen claimed that they saw grey-white fungus growth on the dead fish. Disease could be the cause of massive fish kills based on the apparent anomalies in the affected fish species. The government has not taken any real action to address the issue. It is therefore recommended that partnerships between government and fishermen and fishermen's groups go a long way towards formulating better ideas for managing fishing areas and fisheries resources.

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AUTHORS' CONTRIBUTIONS

OAO is doing research and ideas; HED is doing data analyze; and BSO is doing manuscript preparation and written manuscript.

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