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Perspectives of fishers on the incident of fish kills in Rivers State Coastal Waters, 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 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 and 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.

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

1. 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 and 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 (Liting 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 and Campbell (2005)

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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.

2. 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° 431′ 3411′ North and longitude 6° 55′ 1511′ East in the Niger Delta area of the South-South geopolitical zone. This study was conducted in a coastal fishing community in Rivers State, which is located in the southern part of Nigeria's coastal waters (Figure 1). This study was carried out in Bonny and Andoni Local Government Areas in Rivers State in southern Nigeria. Amariari, Lighthouse, River-7, Agaja, Uku-Mbi, Mbisu 1, Mbisu 2, and Ifoko communities in Bonny LGA; and Oyorokoto in Andoni LGA are among those affected communities.

2.1. Sample size and sampling technique

A multistage purposive sampling procedure was used in the selection of the survey population. At the first stage, a purposive sampling technique was employed for the selection of four communities from the affected communities in the two Local Government Areas namely Amariari, Lighthouse, Ifoko communities in Bonny LGA; and Oyorokoto in Andoni LGA. Data was collected during April–October 2021 from the fishers, who were witnesses to the mass fish kills in the two local government areas and depend on coastal fisheries for livelihoods and food security. Subsequently, random sampling was employed to select fishers to be included in the study. Primary data were collected directly from the respondents using a structured questionnaire. The questionnaire was constructed, taking into account the objectives of the research.

A pilot study was undertaken to assess the questionnaires' suitability using ten respondents who were not part of the target groups. The pilot study aided in ensuring the reliability and validity of the questionnaire. A total of one hundred and fifty were randomly distributed among the affected communities in the two local government areas, of which only one hundred and one were returned. Besides that, several publications and some unpublished reports were collected as secondary data.

2.2. Data Analysis

Simple descriptive and qualitative statistics of frequency and percentages were used in analyzing the data.

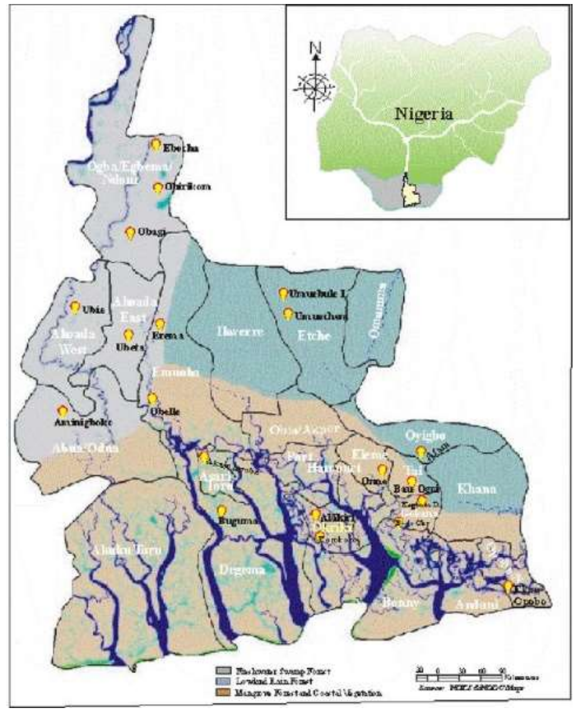

Figure 1. Map of Rivers State showing its Coastal Location

3. Results and Discussion

3.1. Socio-economic characteristics of the fishers

The socio-economic characteristics of the respondents are summarized in Table 1. The majority (54.5%) of respondents were between the ages of 31 and 50, with 17.8 percent being between the ages of 18 and 30, and 27.7 percent being over 50. This indicates that the majority of them are economically active and thus provide a good labour force for fishery enterprises. The implication is that young people are engaging in the profession. Fishers started to fish very young, usually accompanying a relative, such as parents, uncles, or, sometimes, a close neighbour. Kinship relationships are very strong in the use of natural resources, especially in fisheries, promoting the transmission of knowledge from older generations to new ones (Begossi 2008). Male (84.2%) dominated the fishing activities in the coastal waters, while only 15.8 percent were females. Although historically, fishing has been considered a typically male activity, it is significant to note that fishing is not an exclusively male occupation and that the contribution of female is evolving slowly. These results suggest that the contributions of both men and women would be important in addressing issues regarding fisheries management.

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 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.

Table 1
Distribution of fishers by their socio-economic characteristics.

Characteristics	Frequency	Percentage
Age (years)		
18-30	18	17.8
31-50	55	54.5
> 50	38	27.7
Sex		
Male	85	84.2
Female	16	15.8
Level of Education		
No formal education	8	7.9
Primary	33	32.7
Secondary	60	59.4
Length of residence in the fishing village		
1-10 years	15	14.9
11-20 years	29	28.7
>20 years	57	54.9
Years of experience fishing		
<10 years	9	8.9
11- 20 years	22	21.8
>20 years	65	64.4
Analysis of fishing time		
Full- time	85	84.2
Part-time	16	15.8

3.2. Information on the occurrence of massive fish kills

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 and 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. It has perpetuated food insecurity as a result of the death of fish and crops as well as the loss of farmlands 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.

Table 2
Information on the occurrence of massive fish kills.

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

3.3. Observations on the weather and water quality by the fishers before 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 said 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 before the mass fish kills.

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

3.4. 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. Fish kills caused by disease will typically affect only one or two closely related species, occur over 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. 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.

Table 4
Observations on affected or distressed fish species.

Fish species affected	Local name	Frequency	Percentage
Affected fish			
Croaker fish species	Broken marriage	98	97.0
Other fish species		3	3.0
Unusual appearance on the dead fish			
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
Obvious lesions on their body			
Yes		94	93.1
No		7	6.9

Grey/white fungal growth on the dead fish		
Yes	63	62.3
No	30	297
No comment	8	7.9
Fish observed swimming at the surface or jumping onto the bank		
Yes	83	82.
No	18	17.8
Kill is confined to a relatively small section of water way		
Yes	22	21.8
No	79	78.2
Fish are washed up along the shoreline		
Yes	100	99.0
No	1	11

3.5. 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 6
The 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
Size(s) of dead fish		
20-30 cm	28	27.7
>30 cm	73	72.3

3.6. Frequency of occurrence of fish kills in the study area

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 and Quigg, 2008). Therefore, there is a need to establish and enhance monitoring programs to collect baseline data in the affected areas.

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

Frequency of occurrence fish kills in this area per year	Frequency	Percentage
Once	83	82.2
None	16	15.8
Numerous	2	1.98
Total	101	100

3.7. Activities provided by the government to stop fish kills

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 and Gelcich, 2007) highlights the need to test more participatory alternatives in fisheries (e.g., real co-management and community-based management) (Nasuchon and 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.

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

4. 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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