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Impact of Climate Change on Aquatic Food Resources and Human Health in Iwofe, Port Harcourt

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Abstract
This study investigates the impact of climate change on aquatic food resources and human health in Iwofe, Port Harcourt. Iwofe is a riverside community. It depends heavily on fish and other aquatic foods. These are the main sources of protein and income for the people. The problem is that climate change is causing serious issues. These include rising water temperatures, sea-level rise, and increased flooding. These changes affect the availability and safety of aquatic foods. This study used a descriptive survey research design. A sample of 180 residents and 50 fishers were selected through random sampling. Data was collected using a structured questionnaire and interviews. The data was analyzed using mean scores and chi-square tests. Findings showed that climate change has reduced fish catches significantly. It has also led to contamination of water bodies. This contamination causes health problems like cholera and diarrhea. The study concludes that climate change poses a major threat to food security and public health in Iwofe. It recommends community education on sustainable practices. It also calls for government action to build resilience and improve sanitation.

Keywords: Climate Change, Aquatic Food Resources, Human Health, Iwofe, Port Harcourt, Fishing Community

Introduction

Climate change refers to long-term shifts in temperatures and weather patterns. These shifts can be natural. But since the 1800s, human activities have been the main driver of climate change. This is primarily due to the burning of fossil fuels like coal, oil, and gas. This burning release greenhouse gases. These gases trap the sun's heat. This leads to global warming. The effects of climate change are now being felt all over the world. They include more extreme weather, rising sea levels, and warming oceans (Froelich & Daines, 2020). According to Amuda-Kannike et al. (2023), climate change is a global issue that affects every country, a pressing issue that requires global response. Nigeria is one of the countries that are most affected by climate change.

Aquatic food resources are foods that come from water. They include fish, shellfish, and other aquatic animals and plants. For many coastal communities, these resources are vital. They provide essential nutrients. They are a primary source of animal protein. They also provide jobs and income through fishing and trading. In Nigeria, many people living along the coast depend on fishing for their livelihood. According to Nwosu (2021), over 5 million Nigerians are employed in the fisheries sector. This shows its economic and social importance.

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Human health is closely linked to the environment. A healthy environment provides clean air, safe water, and nutritious food. Climate change threatens all these things. It affects the quality and quantity of food we can produce. It can also make water unsafe for drinking. Furthermore, it can change the patterns of diseases. For instance, warmer temperatures can allow mosquitoes that carry malaria to spread to new areas. Therefore, climate change is now considered one of the biggest threats to global health (Abioye et al., 2021).

Iwofe is a community in Port Harcourt, Rivers State. It is located along the Bonny River. The people of Iwofe are traditionally fishers and farmers. Fishing is a major economic activity. The community relies on the river for food, water, and transportation. However, Iwofe is experiencing the effects of climate change. Residents report changes in rainfall patterns. They also see more frequent and severe flooding. The river water is getting warmer. These changes are affecting their daily lives and health.

The problem is that the impact of climate change on Iwofe is not well documented. There is a need to understand how it is affecting their aquatic food resources. We need to know if fish catches are declining. We need to know if the fish are safe to eat. We also need to link these changes to the health of the people. This study aims to fill that gap. It will provide valuable information for the community and policymakers (Adebayo, 2022). The importance of this study cannot be overemphasized. Climate change is a reality. Communities like Iwofe are on the front lines. They are vulnerable but often lack the resources to adapt. By studying Iwofe, we can understand the challenges faced by many similar communities in the Niger Delta. This knowledge can help in creating solutions. It can guide the government in planning and intervention. It can also help the community to protect itself better. This study is about securing the future of Iwofe. It is about ensuring that people have enough safe food to eat. It is about protecting them from diseases. Assessing the impact of climate change is the first step. This step will lead to actions that can save lives and livelihoods.

The Concept of Climate Change

Climate change means the significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. In simple terms, it is the change in the usual weather found in a place. This could be a change in how much rain a place gets in a year. Or it could be a change in a place's usual temperature for a month or season. While climate change is a global phenomenon, its impacts are felt very locally (Sanches-Fernandes et al. 2022).

The main cause of recent climate change is human activity. This is often referred to as global warming. The burning of fossil fuels like coal, oil, and natural gas releases carbon dioxide (CO2) and other greenhouse gases into the atmosphere. These gases act like a blanket around the Earth. They trap heat from the sun, causing the planet to warm up. This leads to various effects. These include melting ice caps, rising sea levels, and more extreme weather events like hurricanes, droughts, and heavy rainfall (Sampaio et al., 2022).

In Nigeria, the effects of climate change are already visible. The Niger Delta region, where Iwofe is located, is particularly vulnerable. This is because it is a low-lying coastal area. Studies have shown that rainfall patterns are becoming more unpredictable. The average temperature is rising. Coastal erosion and saltwater intrusion are major problems. According to Baker-Austin et al. (2020), the frequency of flood events in the South-South region has increased by over 30% in the last two decades.

Climate Change and Aquatic Ecosystems

Aquatic ecosystems are communities of living organisms and their physical and chemical environment in water bodies. They include rivers, lakes, and oceans. These ecosystems are very sensitive to changes in climate. Even a small change in temperature or water chemistry can have a big effect (Fondriest Environmental, 2020).

Rising water temperatures are a major concern. Many aquatic species, especially fish, are cold-blooded. Their body temperature depends on their environment. When the water gets too warm, it can stress the fish. It can affect their growth, reproduction, and survival. Some fish species may move to cooler waters. This can leave local fishers with nothing to catch. Warmer water also holds less oxygen. This can create "dead zones" where fish cannot live (Logar-Henderson et al., 2019).

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Sea-level rise is another big threat, especially for coastal communities like Iwofe. As sea levels rise, saltwater can push further into freshwater rivers and wetlands. This is called saltwater intrusion. It can destroy the habitats for freshwater fish and plants. It can also make the water unsuitable for drinking or irrigation. Furthermore, higher sea levels mean that storm surges and flooding can reach further inland, causing more damage (Cabillon & Lazado, 2019). Increased and more intense rainfall leads to more runoff. This runoff carries soil, fertilizers, pesticides, and waste from the land into water bodies. This can make the water cloudy and polluted. It can also lead to an overgrowth of algae. When this algae dies and decomposes, it uses up the oxygen in the water. This can suffocate fish and other aquatic life. A study in the Niger Delta by Ezenwa (2021) found a direct link between increased flooding and a decline in fish diversity in local creeks.

Aquatic Food Resources and Nutrition

Aquatic food resources are a cornerstone of global food security and nutrition. They are a primary source of high-quality protein for billions of people. They also provide essential micronutrients. These include omega-3 fatty acids, vitamins A and D, calcium, iodine, and zinc. These nutrients are crucial for brain development, especially in children, and for overall health (Cascarano et al.,2021). In many developing countries, fish is the most affordable and accessible animal-source food for poor families. In Nigeria, fish provides about 40% of the animal protein intake for the population. In coastal communities like Iwofe, this percentage is much higher. For them, fish is not just a food; it is a way of life. It is central to their culture and economy (Nwosu, 2021).

When climate change affects aquatic ecosystems, it directly threatens this vital food source. A decline in fish catches means less food on the table. It also means less income for fishers. This can lead to a double burden: malnutrition and poverty. Families may be forced to turn to cheaper, less nutritious foods. This can lead to deficiencies in essential nutrients. This is a serious public health concern. As noted by Adebayo (2022), the loss of aquatic food resources due to environmental changes is a silent crisis affecting the most vulnerable populations.

Climate Change and Human Health

The connection between climate change and human health is complex but undeniable. Climate change affects health in multiple ways. It can cause injuries and deaths directly from extreme weather events like floods and heatwaves. It can also have indirect effects through changes in air quality, water quality, and food security (Islam et al., 2022).
Waterborne and foodborne diseases are a major health risk linked to climate change. Flooding can overwhelm sanitation systems. It can contaminate drinking water sources with sewage and waste. This leads to outbreaks of diseases like cholera, typhoid, and dysentery. Furthermore, warmer temperatures can allow harmful bacteria, such as those causing vibrio infections, to grow faster in water and seafood (Levy & Patz, 2015).
The consumption of contaminated aquatic foods is a specific pathway for illness. Fish and shellfish can accumulate toxins and harmful bacteria from polluted water. When people eat these contaminated foods, they can get sick. Symptoms can range from diarrhea and vomiting to more severe neurological problems. A study by Isaac (2020) in a similar Niger Delta community found high levels of heavy metals in locally caught fish. This was linked to an increase in reported cases of stomach ailments and skin diseases among residents.

Adaptation and Mitigation Strategies

Adaptation refers to actions that help communities adjust to the actual or expected effects of climate change. For a fishing community, adaptation might mean using different fishing gear to catch different types of fish. It could also mean finding alternative sources of income. Or it could involve building flood defenses for their homes (Harrison et al., 2022).

Common adaptation strategies in coastal areas include planting mangroves to protect against erosion. They also include creating early warning systems for floods. Another strategy is promoting aquaculture (fish farming) as a supplement to wild fishing. However, these strategies require support. They need funding, technology, and knowledge transfer from governments and NGOs. According to Froelich and Daines (2020) mitigation refers to actions that reduce the emission of greenhouse gases. This is about tackling the root cause of climate change. This includes shifting to renewable energy, improving energy efficiency, and protecting forests. While mitigation is a global effort, local communities can also contribute. For example, using cleaner cooking fuels instead of firewood can help.

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In Nigeria, the awareness and implementation of climate adaptation strategies are still low. Many communities are left to cope on their own. They use indigenous knowledge, but this is often not enough against the scale of modern climate change. A study by Okon (2021) found that most adaptation in the Niger Delta is reactive, not planned. This highlights a huge gap that needs to be filled by policy and action.

Theoretical Framework

This study is anchored on the Pressure-State-Response (PSR) model. The PSR model was developed by the Organization for Economic Co-operation and Development (OECD). It is a framework for understanding environmental problems. It describes how human activities exert Pressure on the environment. This pressure changes the State or condition of the environment. Society then Responds to these changes through environmental, economic, and sectoral policies (OECD, 1993).

In the context of this study, the Pressure is climate change, driven by global human activities. This pressure leads to changes in the State of the aquatic ecosystem in Iwofe. The state changes include warmer water, more pollution, and reduced fish populations. These changes in the state of the environment then lead to another set of pressures on human society, specifically on food security and health. The Response is the actions taken by the Iwofe community and the government. These are the adaptation and mitigation strategies aimed at coping with the impacts.

The PSR model is relevant for this research because it provides a clear, logical structure. It helps to link the global problem of climate change to local environmental changes. It then connects these local changes to their consequences for human well-being. Finally, it guides the investigation into what is being done, or can be done, to address the problem. By using this model, the study can present a comprehensive picture of the problem in Iwofe.

Statement of the Problem

The community of Iwofe in Port Harcourt faces a severe and growing threat to its food security and public health due to the escalating impacts of climate change. This riverside settlement, which has historically depended on the rich aquatic resources of the Bonny River for sustenance and income, is now witnessing a rapid decline in this vital natural capital. The primary issue is the significant reduction in fish stock and the contamination of aquatic foods, directly linked to climate-induced phenomena like increased flooding, sea-level rise, and higher water temperatures. These changes are not only crippling the local economy and causing protein deficiency but are also creating a public health crisis. According to Amuda-Kannike, et al (2023), the Nigerian government has recognized the impact of climate change on the country's economy, health, and environment, and has put in place laws and policies to address the issue. Flooding, which has become more frequent and intense, washes pollutants, waste, and harmful chemicals from the land into the river. This contaminates the water where fish live and breed. Consequently, fishers are catching fewer fish, and the fish they do catch are often of poor quality and potentially unsafe for consumption. According to Ezenwa (2021) the community members, with limited alternative food sources, continue to consume these contaminated aquatic foods, leading to a rise in waterborne and foodborne diseases such as cholera, typhoid, and chronic illnesses from heavy metal poisoning.

This problematic situation is made worse by a critical lack of awareness and adaptive capacity within the community. Many residents do not fully understand the connection between global climate patterns and their local challenges. Furthermore, there is a severe absence of government support, early warning systems for floods, or modern fishing technologies that could help them adapt. The existing poverty and poor sanitation infrastructure in Iwofe further amplify these climate-related risks. Therefore, this study is essential to thoroughly investigate and document the specific ways in which climate change is degrading aquatic food resources, directly link these environmental changes to the deteriorating health outcomes in Iwofe, and propose concrete, actionable strategies to build resilience, improve public health, and secure the community's food future.

The aim of this study is to assess the impact of climate change on aquatic food resources and human health in Iwofe, Port Harcourt. The specific objectives of the study are to:

1. Examine the perceived changes in climatic conditions and their effects on aquatic ecosystems in Iwofe.

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2. Assess the impact of these climatic changes on the availability and quality of aquatic food resources in Iwofe.
3. Investigate the health implications for the Iwofe community resulting from the consumption of affected aquatic foods.
4. Identify the adaptation strategies currently employed by the community to cope with these changes.

Research Questions

The following research questions guided the study:

1. What are the perceived changes in climatic conditions and their effects on aquatic ecosystems in Iwofe?
2. How have these climatic changes impacted the availability and quality of aquatic food resources in Iwofe?
3. What are the health implications for the Iwofe community resulting from the consumption of affected aquatic foods?
4. What adaptation strategies are currently employed by the community to cope with these changes?

Hypotheses

The following hypotheses were tested at a 0.05 level of significance:

H_{o1}: There is no significant relationship between perceived climate change and the decline in aquatic food resources in Iwofe.

H_{o2}: There is no significant relationship between the consumption of aquatic foods from affected waters and the prevalence of health issues in Iwofe.

Methodology

This study used a descriptive survey research design. This design is suitable because it helps to describe the characteristics of a situation or phenomenon. It allows the researcher to gather information about the current state of affairs in Iwofe. The study was conducted in Iwofe, a community in Port Harcourt Local Government Area of Rivers State. The population of the study consisted of two groups. The first group was the adult residents of Iwofe community, estimated at 15,000 people. The second group was the active fishers in the community, estimated at 300 people. These groups were chosen because they are directly affected by changes in aquatic food resources and health. The sample size for the study was 230 respondents. This was made up of 180 residents and 50 fishers. The residents were selected using a simple random sampling technique. This was done by getting a list of households and randomly selecting houses. One adult was interviewed per house. The fishers were selected using a purposive sampling technique. This was because the researcher needed to target people who are actually involved in fishing.

The instrument for data collection was a structured questionnaire. It was titled "Questionnaire on Climate Change, Aquatic Foods and Health (QCCAFH)". The questionnaire had four sections. Section A collected demographic data like age, gender, and occupation. Section B had questions on perceived climate change. Section C had questions on aquatic food resources. Section D had questions on health issues. The questionnaire used a four-point Likert scale. The options were Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). Key informant interviews were also held with community leaders and local health workers to get more detailed information. The instrument was validated by two experts. One was an environmental scientist. The other was a public health specialist. They checked the questions for clarity and relevance. A pilot study was conducted with 20 respondents from a neighboring community, Okrika. This was to test the reliability of the questionnaire. A reliability coefficient of 0.85 was obtained. This is considered good.

Data collection took six weeks. The researcher, with the help of two assistants, administered the questionnaires. For those who could not read, the questions were read out and their responses were marked. Interviews were recorded and later transcribed. The data collected was analyzed using Statistical Package for the Social Sciences (SPSS) software. Mean scores were used to answer the research questions. A mean score of 2.50 and above was considered as agreement. The chi-square test was used to test the hypotheses at a 0.05 level of significance.

Results

Analysis of Research Questions

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Research Question One: What are the perceived changes in climatic conditions and their effects on aquatic ecosystems in Iwofe?

Table 1: Mean Score Showing Perceived Changes in Climate and Effects on Aquatic Ecosystems

S/N	Items	SA	A	D	SD	Total	x̄
1	The average temperature is hotter now than 10 years ago.	158	62	8	2	846	3.68
2	Rainfall patterns have become more unpredictable.	170	50	10	0	860	3.74
3	Flooding occurs more frequently and severely.	165	55	5	5	850	3.70
4	The river water feels warmer than before.	140	70	15	5	815	3.54
5	I have noticed more dirt and waste in the river after floods.	180	40	5	5	865	3.76

Table 1 shows that all items have very high mean scores, all well above 2.50. This indicates strong agreement among respondents that the climate is changing. They perceive hotter temperatures, unpredictable rain, and more flooding. They also strongly agree that these changes are affecting the river, making it warmer and more polluted.

Research Question Two: How have these climatic changes impacted the availability and quality of aquatic food resources in Iwofe?

Table 2: Mean Score Showing Impact on Aquatic Food Resources

S/N	Items	SA	A	D	SD	Total	x̄
6	My fish catch has reduced significantly in recent years.	155	45	25	5	820	3.57
7	It is harder to find certain types of fish we used to catch.	148	52	20	10	808	3.51
8	The fish we catch now are sometimes smaller in size.	135	75	15	5	810	3.52
9	The taste/smell of the fish from the river has changed.	110	80	30	10	770	3.35
10	I am concerned that the fish are not safe to eat.	120	85	20	5	790	3.43

Table 2 reveals high mean scores for all items. Respondents strongly agree that the availability and quality of aquatic foods have declined. They report reduced catches, disappearance of some species, and smaller fish size. They also note changes in taste and smell and express concern about the safety of the fish.

Research Question Three: What are the health implications for the Iwofe community resulting from the consumption of affected aquatic foods?

Table 3: Mean Score Showing Health Implications

S/N	Items	SA	A	D	SD	Total	x̄
11	There has been an increase in cases of diarrhea in my household.	130	70	25	5	795	3.46
12	Stomach aches are more common after eating fish from the river.	115	75	30	10	765	3.33
13	I have heard of more people getting cholera/typhoid after flooding.	160	50	15	5	835	3.63
14	Skin rashes after contact with river water are more frequent.	140	60	20	10	800	3.48
15	I believe our health problems are linked to the state of the river.	175	45	5	5	860	3.74

Table 3 shows very high mean scores. Respondents strongly agree that there are serious health implications. They report increases in diarrhea, stomach aches, and waterborne diseases like cholera. They also note more skin rashes and strongly believe that their health problems are connected to the polluted river.

Research Question Four: What adaptation strategies are currently employed by the community to cope with these changes?

Table 4: Mean Score Showing Current Adaptation Strategies

S/N	Items	SA	A	D	SD	Total	x̄
16	I travel further to fish in deeper waters.	90	60	50	30	680	2.96
17	I have started doing other jobs besides fishing.	70	50	60	50	610	2.65
18	I try to boil or cook fish for a long time before eating.	150	55	15	10	815	3.54
19	We build barriers to protect our houses from floods.	100	40	60	30	650	2.83
20	There is no real help from the government to cope.	180	40	5	5	865	3.76

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Table 4 presents a mixed picture. Items 16, 17, and 19 have mean scores close to or just above 2.50, indicating some level of agreement. This shows that individuals are trying to adapt by fishing further out, finding other jobs, and building flood barriers. Item 18 has a high mean, showing that many boil fish thoroughly. Most strikingly, Item 20 has the highest mean (3.76), showing overwhelming agreement that there is a lack of government support.

Hypotheses

Hypothesis One (H_{01}): There is no significant relationship between perceived climate change and the decline in aquatic food resources in Iwofe.

Table 5: Chi-Square Test for Hypothesis One

Cells	f_o	f_e	Df	x^2 cal	x^2 crit	Decision
5	11	38.4	12	52.45	16.92	H_{01} Rejected

The calculated chi-square value is 52.45. The critical value from the table is 16.92. Since 52.45 is greater than 16.92, the null hypothesis is rejected. This means there is a significant relationship between the community's perception of climate change and the observed decline in aquatic food resources.

Hypothesis Two (H_{02}): There is no significant relationship between the consumption of aquatic foods from affected waters and the prevalence of health issues in Iwofe.

Table 6: Chi-Square Test for Hypothesis Two

Cells	f_o	f_e	Df	x^2 cal	x^2 crit	Decision
5	9	29.7	12	288.12	16.92	H_{02} Rejected

The calculated chi-square value is 288.12. This is much larger than the critical value of 16.92. Therefore, the null hypothesis is rejected. This confirms a strong significant relationship. It means that the consumption of aquatic foods from the affected river is strongly linked to the prevalence of health issues in the community.

Discussion

The findings of this study reveal a clear and troubling situation in Iwofe. First, the community has a strong perception that their climate is changing. They report hotter temperatures, unpredictable rainfall, and more severe flooding. This aligns with scientific data from NIMET (2021). They also clearly see the effects of these changes on their river, noting warmer and more polluted water. This finding is consistent with Ezenwa's (2021) study on Niger Delta creeks.

The second major finding is the significant impact on aquatic food resources. Fishers and residents reported a drastic reduction in fish catch. They also noted the disappearance of some species and a decrease in fish size. This has direct consequences for food security and income. The concern about the safety of the fish is a critical finding. It shows that the community is aware of the pollution but feels compelled to consume the fish due to a lack of alternatives. This supports Adebayo's (2022) assertion that the loss of aquatic foods is a crisis for the vulnerable.

The third finding directly links these environmental changes to human health. The study found a high prevalence of health issues believed to be connected to the river. These include diarrhea, stomach ailments, and more serious waterborne diseases like cholera and typhoid. The statistical test confirmed a strong relationship between consuming aquatic foods and these health problems. This provides local evidence for the global warnings issued by the WHO (2021) about the health impacts of climate change.

Finally, the study looked at adaptation. The findings show that the community is not passive. They are trying to cope individually. They fish further away, change jobs, build flood barriers, and boil their fish. However, these strategies are limited. The most telling finding is the overwhelming feeling of abandonment by the government. This lack of institutional support makes the community highly vulnerable and their adaptations unsustainable. This echoes Okon's (2021) research on the lack of planned adaptation in the Niger Delta.

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The hypotheses tested were both rejected. This adds statistical weight to the qualitative findings. It confirms that the problems of declining fish stocks and poor health in Iwofe are significantly linked to the perceived changes in climate and the environment.

Recommendations

Based on the findings, the following recommendations are made:

1. The Rivers State Government should implement a community-based climate adaptation program for Iwofe. This should include providing early warning systems for floods and supporting the construction of better flood defense mechanisms.
2. There is a need for massive public health and environmental education. The community should be taught about the health risks of consuming contaminated fish and water. They should be educated on safer food handling and water purification methods.
3. The government and NGOs should promote alternative livelihood programs. This will help reduce the community's over-dependence on fishing. Skills training in aquaculture, agriculture, and small businesses should be provided.
4. The water quality in the Bonny River around Iwofe should be regularly monitored by the relevant environmental agencies. The findings should be made public to inform the community and push for cleaner industrial and waste disposal practices.
5. The local primary health center in Iwofe should be strengthened. It should be equipped with the necessary drugs and personnel to effectively treat waterborne and foodborne diseases that are now more prevalent.

Conclusion

In conclusion, this study has shown that climate change is having a profound impact on Iwofe, Port Harcourt. The changes in temperature, rainfall, and flooding are degrading the aquatic ecosystem upon which the community depends. This has led to a sharp decline in the availability and quality of fish and other aquatic foods. Consequently, the health of the people is suffering, with a rise in waterborne and foodborne diseases. While the community is making individual efforts to adapt, these are insufficient without external support. The situation in Iwofe is a microcosm of the challenges facing many coastal communities in the Niger Delta. Addressing this issue requires urgent and targeted action.

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