

Assessing perceptions and adaptation responses to climate change among artisanal fishermen in Region 6, Guyana

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Abstract

Artisanal fishermen in Region 6, Guyana, currently face many challenges linked to the impacts of climate change. These challenges force fishermen to adapt in an effort to continue this aspect of their livelihood. In this study, perceptions of fishermen regarding climate change, its impacts and adaptation strategies employed by fishermen were investigated. Fifty fishermen from Administrative Region 6, East Berbice, Corentyne were randomly selected to participate in a questionnaire survey. The findings revealed that the respondents have a good understanding of climate change, its causes, challenges and consequences. Major challenges identified were limited support from fisheries extension officers, damage to fishing equipment, limited financial resources, and competition from other fishermen. Among the adaptive measures used by fishermen were fishing in non-traditional fishing areas, fishing for longer periods and engaging fishing cooperatives, all strategies that did not require significant financial outlays. There is need for a mutual working relationship between fishermen and extension officers from the Department of Fisheries. Such a relationship will be very useful if and when the perceptions of local fishermen about climate change are understood and used to influence their decisions and actions on adaptation measures as well as policies and supporting initiatives that can help cushion the impacts of climate change.

Keywords: Artisanal; Fishermen; Climate Change; Perception; Adaptation; Challenges; Impact; Guyana

1. Introduction

Globally, the fisheries sector is recognized for its vital role in seafood production, employment, revenue generation, and contribution to national economies [7]. Fishermen in coastal areas rely on the fisheries sector for a living [10], and studies have reported that they are also impacted by climate change [10, 16].

The Fisheries sector in Guyana is made up of three primary components: Marine, Aquaculture and Inland Fishery and the sector is managed by the Fisheries Department, which has the responsibility for promoting the sustainable use and development of the nation's fishery resources, while managing and regulating it for the benefit of sector participants and the national economy.

Climate change has been observed and has impacted many regions globally [4, 8] and these impacts have affected coastal and marine areas, with fishermen experiencing much of these impacts as well as the impacts of changes in seasonal weather and climate patterns [12]. Such impacts and shifts in the weather patterns often jeopardizes efforts to achieve global food security, alleviate poverty, and promote sustainable development. Further, the negative effects of climate change have also imposed a major strain on coastal and marine ecosystems and human populations, of which sea-level rise, rising temperatures, and decreased rainfall are just a few [9].

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There is a general feeling among fishermen that changes being experienced in seasonal patterns may be attributed to climate variability and climate change, which are linked to global warming [12]. There are two main types of impacts (ecological and socioeconomic impacts) that have been recognized as being caused by climate change. In terms of the fishery sector, ecological changes include changes in fishing areas, fishing seasons and increased risks being at sea in high energy conditions. The improbability of a profitable catch and the associated financial implications are also key socioeconomic impacts of climate change [12].

Fishermen are increasingly aware of rising trends in air temperature, seawater temperature, interior precipitation, offshore precipitation, and storms [6, 9, 11, 17]. Recent studies have shifted the global outlook from an early focus on the need for climate change awareness and adaptation for fisher-folks to one that pays attention to the choosing of appropriate and efficient adaptation options [19].

In Guyana, climate change impacts on aquatic ecosystems are severe and pervasive, with the fishing industry being particularly heavily impacted [3]. With the current transition to an oil producing economy, some individuals are of the opinion that the traditional economic sectors, such as the fishery sector, is experiencing some reduction of importance. Some stakeholders also are of the perception that the issues and challenges that are affecting the fishing industry may be the result of this diminishing attention and overlooking of the sector.

This study of fishermen's perceptions of climate change, challenges and adaptations is therefore important and an individuals' knowledge of climate change, can influence their perception and decision on adaptation measures in the many challenges that arise from climate change [14, 18].

2. Methodology

2.1. Study Location

This study was conducted in Region 6, East Berbice-Corentyne, Guyana and focused mainly on fishermen from two fisheries landing sites in Upper Corentyne, Berbice, Guyana. These sites were chosen because a high concentration of fishermen was located in the two areas and it was easier to travel to and access the two locations.

2.2. Instrumentation and Implementation

Data for this research were collected using a pretested questionnaire which was distributed and collected during a two-week period. A purposive sampling method was used to determine the fifty respondents in the study (twenty-five from each of the two sites). Before the survey was conducted, the validity and reliability of the research instrument was determined.

The questionnaire was divided into four main sections which addressed the following aspects: demographic characteristics of respondents, respondents' knowledge of climate change, climate variability and climate adaptation, respondents' perceptions of the impacts of climate change and respondents' perceptions of climate adaptation strategies. A four-point Likert scale was used to measure perceptions of climate change impacts and climate mitigation strategies.

2.3. Data Analysis

Data analysis was completed using Statistical Package for Social Sciences (SPSS version 23) to obtain descriptive and inferential statistics. The descriptive statistics used for this analysis were a measure of central tendency (mean) and a measure of variability (standard deviation). Frequencies and relative proportions were used to summarize the data from the questionnaire, and these were displayed as graphs and tables.

3. Results and Discussion

3.1. Fishermen's perception, knowledge and awareness of climate change and climate variability

The data presented in Table 1 reveal the means and standard deviation of items that addressed fishermen's perception, knowledge and awareness of climate change and climate variability. While respondents demonstrated agreement with all statements they were apparently unsure as to whether climate change and climate variability were the same ($M=1.96$; $SD=0.35$). The results show that statistically, fishermen displayed an overall agreement ($M=2.82$; $SD=0.99$) towards the items relating to perception, knowledge and awareness of climate change and climate variability.

Table 1 Perception, knowledge and awareness of climate change and climate variability

Statements	Frequencies (%)				Mean (M)	Standard Deviation (SD)
	1	2	3	4		
Climate change only refers to variations that persist for longer periods of time, typically decades.	12 (24%)	2 (4%)	9 (18%)	27 (54%)	3.02	1.25
Climate variability is the long-term continuous change in average weather conditions.	5 (10%)	10 (20%)	15 (30%)	20 (40%)	3	1.01
Climate change and climate variability are the same.	4 (8%)	44 (88%)	2 (4%)	0 (0%)	1.96	0.35
Climate variability includes all the variations in the climate that last longer than individual weather events	4 (8%)	16 (32%)	8 (16%)	22 (44%)	2.96	1.05
Climate change is the result of increased amounts of pollution such as carbon dioxide in the atmosphere.	4 (8%)	16 (32%)	7 (14%)	23 (46%)	2.98	1.06
Climate change is a consequence of human activities that pollute the atmosphere.	12 (24%)	2 (4%)	9 (18%)	27 (54%)	3.02	1.25
Total Average Mean					2.82	0.995

Key: (1) Strongly disagree (2) Disagree (3) Agree (4) Strongly agree

Overall, while respondents were apparently aware of climate change, some respondents were not too familiar with climate variability and whether it was the same or different from climate change. This finding is somewhat similar to what was reported by Muringai *et al.*, 2019 [14]; Muringai *et al.*, 2022 [13] and Amoutchi *et al* 2021 [2], who all noted that fishermen were cognizant of climate change.

3.2. Respondents' perception about consequences and challenges of climate change

The results of the section of the study that assessed respondents' perceptions about consequences and challenges of climate change (Table 2) indicate that the respondent fishermen were in strong agreement with all of the statements provided about the consequences and impacts that fishermen face as a result if climate change (M=3.72; SD=0.59).

Two main consequences of climate change that had the highest means were the fact that fishermen indicate that they spent longer periods fishing so that enough fish is caught to make the fishing trip profitable (M=3.92; SD=0.34) and because of the dangerous conditions at sea in the form of severe weather conditions, fishermen noted the need for greater safety awareness (M=3.92; SD=0.34). Noteworthy was that fishermen reported decreases in the quantity of fishes caught (M=3.90; SD=0.36) and they had to fish further away from traditional fishing grounds ((M=3.82; SD=0.72).

These findings appear consistent with those from other studies [5, 6, 9, 11, 17] where it was reported that fishermen are aware of rising trends in air temperature, seawater temperature, interior precipitation, offshore precipitation, and storms that are somewhat linked to climate change events as well as a reported decrease in quantity of fish caught.

Table 2 Respondents' perception about consequences and challenges of climate change

Statements	Frequencies (%)				Mean (M)	Standard Deviation (SD)
	1	2	3	4		
As a result of climate change there is/are:						
A decrease in quantity of fishes caught.	0 (0%)	1 (2%)	3 (6%)	46 (92%)	3.9	0.36
A decrease in the size of fishes caught.	0 (0%)	6 (12%)	4 (8%)	40 (80%)	3.68	0.68
A reduction in fish diversity and catch.	4 (8%)	6 (12%)	12 (24%)	28 (56%)	3.28	0.97
I have to fish further away in other areas.	3 (6%)	0 (0%)	0 (0%)	47 (94%)	3.82	0.72
Increase in overall cost of a fishing trip.	0 (0%)	4 (8%)	18 (36%)	28 (56%)	3.48	0.65
An increase in temperature.	2 (4%)	13 (26%)	1 (2%)	34 (68%)	3.34	1.00
An increase in rainfall.	0 (0%)	0 (0%)	2 (4%)	48 (96%)	3.96	0.20
An increase in the rough sea conditions.	0 (0%)	3 (6%)	3 (6%)	44 (88%)	3.82	0.52
A decrease in income because less and smaller fishes are caught.	2 (4%)	2 (4%)	2 (4%)	44 (88%)	3.76	0.72
Longer periods spent fishing to catch enough fish to make fishing profitable.	0 (0%)	1 (2%)	2 (4%)	47 (94%)	3.92	0.34
A greater awareness for safety because of weather changes which make it dangerous.	0 (0%)	1 (2%)	2 (4%)	47 (94%)	3.92	0.34
Total Average Mean					3.72	0.59

Key: (1) Strongly disagree (2) Disagree (3) Agree (4) Strongly agree

3.3. Adaptation strategies used by fishermen to cope with the impacts of Climate Change

Fishermen in this study were provided with a suite of adaptation options and were asked which of the options they had used as a coping strategy to alleviate the impacts of climate change on their fishing operation. Respondents identified the strategies that they used (Figure 1) and the top three strategies used were extension of fishing areas (96%), fishing for longer periods (94%) and working as cooperatives (86%). Adaptation strategies least used were diversifying livelihood options (14%), exploring the possibility of aquaculture (22%) and changing fishing gear (38%).

Further analysis of this aspect of the study was undertaken to determine the frequency with which fishermen used each adaptive strategy and the results showed overall agreement with the use of the options (M=3.08; SD=0.77). The results (Table 3) revealed that the most popular adaptation strategy was the one where fishermen extended the areas that they fished, with 96% of all respondents reporting that they extended the area that they fished beyond the traditional fishing areas (M=3.88; SD=0.44) in an effort to increase their catch. Fishers who selected this option stated that they moved further away from traditional areas because the fishes appeared to not be available at the traditional fishing areas.

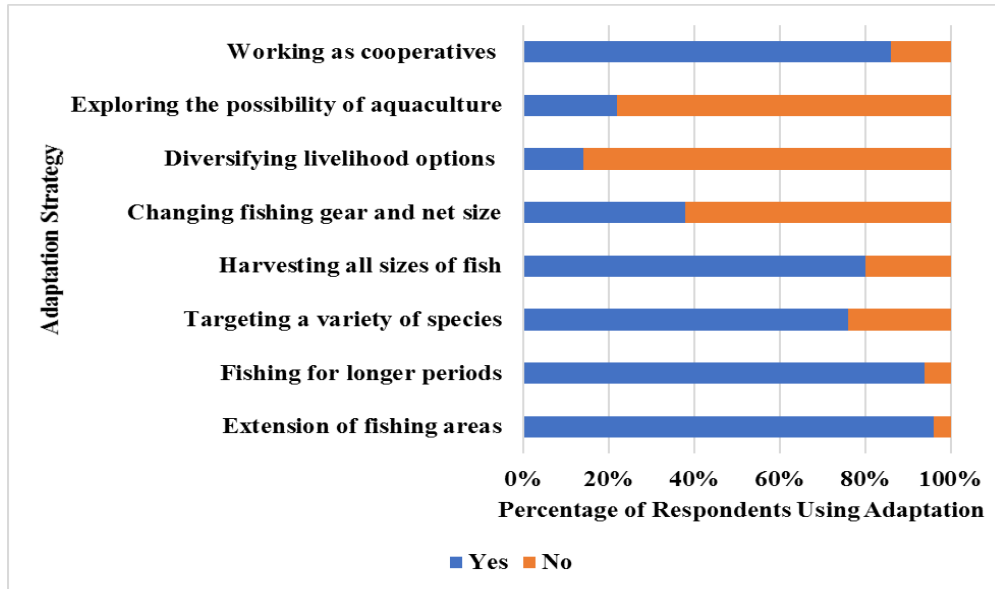


Figure 1 Adaptation strategies used by fishermen to cope with the impacts of climate change

Table 3 Adaptation strategies used to cope with impacts and consequences of climate change

Statements	Frequencies (%)				Mean (M)	Standard Deviation (SD)
	1	2	3	4		
Extension of fishing areas.	0 (0%)	2 (4%)	2 (4%)	46 (92%)	3.88	0.44
Fishing for longer periods.	0 (0%)	3 (6%)	1 (2%)	46 (92%)	3.86	0.50
Targeting a variety of species.	0 (0%)	12 (24%)	7 (14%)	31 (62%)	3.38	0.85
Harvesting all sizes of fish.	0 (0%)	10 (20%)	9 (18%)	31 (62%)	3.42	0.81
Changing fishing gear type and net size.	1 (2%)	30 (60%)	5 (10%)	14 (28%)	2.64	0.92
Diversifying livelihood options by trying new income earning activities.	3 (6%)	29 (58%)	2 (4%)	5 (10%)	2.23	0.78
Exploring the possibility of aquaculture.	14	25 (50%)	9 (18%)	2 (4%)	1.98	0.80
Working as cooperatives rather than as individuals.	2 (4%)	5 (10%)	4 (8%)	39 (78%)	3.6	0.83
Collecting and recording catch data and sharing with the Department of Fisheries.	5 (10%)	17 (34%)	13 (26%)	15 (30%)	2.76	1.00
Total Average Mean					3.08	0.77

Key: (1) Strongly disagree (2) Disagree (3) Agree (4) Strongly agree

Other popular adaptive strategies used were “Fishing for longer periods” (94%), “Targeting a wider variety of species” (76%) and “Harvesting all sizes of fish” (80%) and “Working as cooperatives rather than as individuals” (86%) were

adaptive strategies that most respondents reported using. All of the strategies used were intended to make the fishing venture profitable.

Interestingly, only 14% of all respondents reported that consideration was given to diversify their livelihood options by trying new income earning activities. The reason given for this was mainly that fishing was all they knew and it was difficult to now seek restart learning new skills. This very reason was given as to why only 22% of respondents gave some consideration to exploring aquaculture possibilities. The main reason given for this was that it was an activity that could utilize their fishing skills, even though it was markedly different from the regular kind of fishing activity they were engaged in. However, this option was still kept open by many of the respondents.

“Collecting and recording catch data and sharing with department of fisheries” was identified as a strategy by 56% of respondents. Respondents stated that representatives from the Fishery Department would collect such information. Fishermen reported their willingness to comply with the request, because of the possibility that the data would be used to assess fishing and harvesting trends, and ultimately inform policy that can improve the sustainability of the fishery.

Only 38% of respondents said that they adjusted their gear type as a strategy. The reason given for this not being a greater option, was the financial cost associated with undertaking such changes. Fishermen reported that they were already struggling financially and so to invest in new gear was not a viable option.

3.4. Challenges experienced by fishermen while coping with climate change impacts

Figure 2 shows how fishermen responded when asked about the challenges they face as a result of climate change and its impacts. The most challenging issue reported by fishermen as they attempt to adapt to climate change is inadequate support from fisheries extension officers.

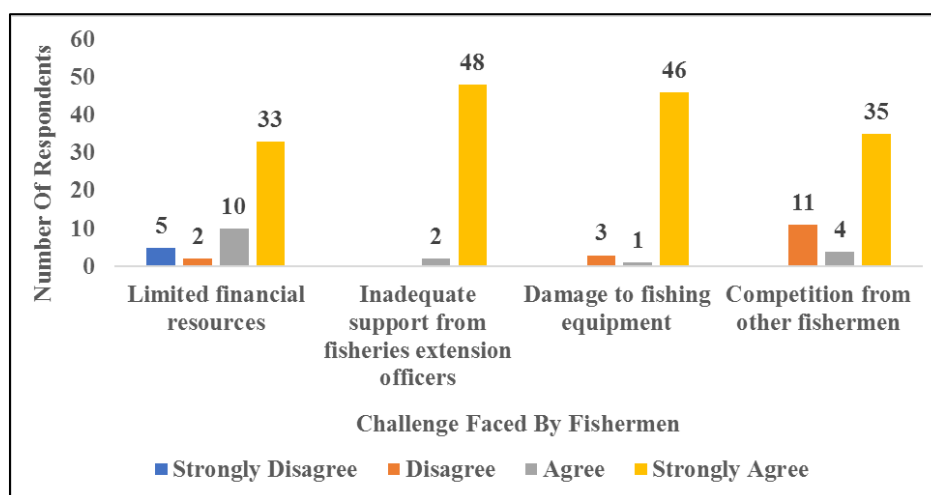


Figure 2 Challenges experienced by fishermen

Figure 3 reflects the respondents' opinions regarding the support provided by the Department of Fisheries.

The majority of respondents did not agree that adequate support was provided by the Department of Fisheries to adequately prepare them for adapting to the impacts of climate change. Respondents were of the opinion that with greater support, even in the form of information, they would be better able to cope and identify appropriate adaptation strategies for the challenges they face.

When these findings are compared with those of other studies, some similarities were observed. Muringai *et al.*, 2019 [14], reporting on a study conducted in Zimbabwe, noted that damage to fishing equipment from floods due to heavy rainfall, was a major challenge faced by fishermen. These findings also correspond the findings of Adewale, *et al.* 2017 [1] who reported on vulnerability and adaptation strategies of fishermen to climate change. However, when comparing the level of support provided to fishermen by extension officers, it was evident that while the respondents in this current study were of the opinion that more support could have been given as was reported in another study by Norsida *et al.*, 2018 [15].

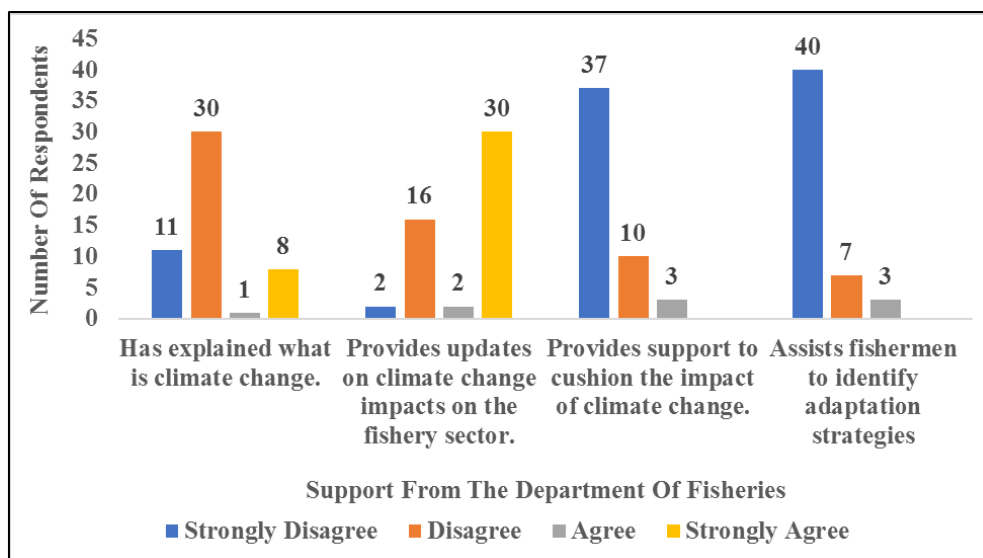


Figure 3 Respondents' opinions regarding support provided by the Department of Fisheries

4. Conclusions and Recommendations

While fishermen in this study have a fairly good perception of climate change and the causes, this was not the case for climate variability. Generally, respondents' perceptions of climate change are likely influenced by their lived experiences, and their observations of the environmental changes associate with climate change and the impacts of fish harvesting.

The results of this study have revealed that the perception that respondent fishermen in the study have towards Fishery Extension Officers is low and the support they provide could be improved. This study has therefore underscored the need for an improved relationship between fishermen and the Department of Fisheries. Fishermen have reported that while they experience many challenges, they are of the opinion that more can be done by the relevant authorities to help them cushion the effects of climate change. Respondents believe that they will be in a better position to cope by choosing appropriate adaptation strategies.

It is expected that climate change will continue to impact fishermen and their livelihoods. As such it is imperative that fishermen adapt and adopt appropriate climate mitigation strategies if they are to continue operating a profitable and sustainable fishing activity. Therefore, given the significant contribution that the fishery sector makes to the economic and social fabric of the Guyanese society, then it is imperative that the perspectives and perceptions of fishermen should be considered, if policies are to be developed which will strengthen adaptation responses to the impacts of climate change on the fishery sector.

Compliance with ethical standards

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Disclosure of conflict of interest

The authors certify that this submission is original work and is not under review at any other publication. The authors hereby declare that this manuscript does not have any conflict of interest.

Statement of informed consent

The authors declare that informed consent was obtained from all individual participants included in the study. All work utilized in this study was fully cited and referenced so authors of prior researches are given their due credentials for their work.

Data Availability

Data will be made available on request.

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