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Knowledge and Perspectives of Residents in Grenada Regarding Climate Change and the Impacts on the Coastal Environment

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Abstract

Objective: The authors conducted this study to assess the knowledge, attitudes, and practices of residents in two parishes in Grenada with regard to climate change and coastal and marine ecosystems. **Method:** A cross-sectional study was conducted with a survey administered to 220 residents in two parishes, St. John and St. Mark, which lie along the west coast in Grenada. **Results:** At least 50% of the respondents correctly identified factors that can contribute to climate change although the majority, 52.6%, also stated they were "somewhat informed" about impacts of climate change and mitigation measures. Overall, about 90% of respondents did not participate in programmes to raise awareness about climate change or coastal ecosystem management in the past five years. Residents who completed their education lower than college, residents above 45 years and residents in St. Mark were found to have significantly lower levels of knowledge and awareness about climate change and coastal ecosystem. Together, almost 50% of respondents reported they were somewhat concerned, not concerned at all or not sure if they should be concerned about climate change. In each case, more than 50% of the respondents also felt communities were prevented from taking action due to lack of knowledge, cooperation, and resources. There was moderate to high support for designating Marine Protected Areas in St. John and St. Mark. **Conclusion:** Residents in St. John and St. Mark need to increase their knowledge and awareness of the relationship between climate change, coastal and marine ecosystem, and community development and sustainability. Increasing knowledge about climate change is also expected to have a positive effect on the residents' participation in the Coastal Protection for Climate Change Adaptation in Small Island States project.

Keywords

Grenada, Climate Change, Marine Protected Area, Marine Ecosystem, Coastal Ecosystem, St. John, St. Mark

1. Introduction

The Community-based Coastal Ecosystem Management for Climate Adaptation in Selected Areas of Grenada Project constitutes part of a larger Caribbean Community Climate Change Centre (5Cs) project. The project in Grenada included a community knowledge baseline study with qualitative and quantitative components. The study was conducted to assess the knowledge and attitudes of residents in two parishes—St. Mark and St. John—which lie along the western coast of Grenada and bordered by the Caribbean Sea. Grenada is a small island in the southern part of the Caribbean with a population of about 105,000 residents. As a small island state, the country is especially vulnerable to the effects of climate change but has limited resources to combat the impacts [1] [2]. As such, the study was conducted to identify gaps in knowledge and practices that will need to be addressed to improve the management and sustainability of the marine and coastal resources. The qualitative study and findings were published in the American Journal of Climate Change [3]. This quantitative component of the study included a cross-sectional survey with residents randomly selected in St. Mark and St. John. The study was funded by the German Ministry for Economic Cooperation and Development (BMZ) through support to 5Cs for the Coastal Protection for Climate Change Adaptation in Small Island States. In Grenada, the project was implemented by the Grenada Community Development Agency (GRENCODA). The overall goal of the project was to pursue the implementation of local adaptation measures for the sustainable improvement of coastal ecosystems relevant to climate change adaptation.

2. Methodology

2.1. Development of the Questionnaire

Three focus groups were conducted in the first phase of the study and the themes that emerged in the discussions were used in the development of the questionnaire. Similar studies that were available online were reviewed to provide information on possible themes and questions that could be included in this study. Questions that were considered appropriate were adopted and modified to fit the local context, following which the questions were piloted with 8 residents to receive feedback on clarity and appropriateness and adjusted as necessary. The themes that emerged from the focus group discussions were also used in the development of the questionnaire. The final questionnaire included a mixture of primarily closed-ended questions.

2.2. Sampling

A sample size of 200 residents was pre-determined for inclusion in the survey. A mixed approach was used in sampling involving multi-stage clustering of fishers, residents in closest proximity to the coastline—that is, residing in a community that is bordered by the coastline—and residents across other communities in the parishes.

The members of Gouyave Fishermen Cooperative Society Ltd. and fishers from St. Mark's were randomly selected to participate in the study. A proportional number of participants were selected from each group based on the total listing and, together, totaling 25% (50 participants) of the overall sample.

The Central Statistics Office (CSO) provided a list of communities that were bordered by the western coastline in St. John (Maran, Palmiste, Grand Roy, Black Bay, Concord, Gouyave, Marigot,) and St. Mark (Waltham, Union, Duquesne, NonPariel, Industry, Victoria). The households were randomly selected from which participants were recruited. A total of 25% (50 participants) of the overall sample was included from these communities.

A total of 21 Enumeration Districts (ED) were randomly selected for inclusion in the study—14 ED in St. John and 7 ED in St. Mark. A proportionate number of participants were selected in each ED based on the total number of households and, together, totaling 50% (100 participants) of the overall sample. Enumeration maps were used to demarcate the ED and to identify the selected households of participants within the respective ED.

2.3. Recruitment

To recruit the participants in the coastal communities and in other communities in the parishes, the adult (person above 18 years) with the next birthday was identified in the selected household. One member per household was interviewed. The inclusion criteria were physically present in the country at the time of the survey and age 18 years or older. The exclusion criteria were the individual not physically present in the country at the time of the survey, unwilling or unable to participate, mentally incapable, participated in the focus group, participated in piloting the questionnaire, member of the household previously interviewed and age under 18 years. The closest nearby household was selected to replace one in which the selected person did not meet the inclusion criteria or was absent after two attempts to make contact.

2.4. Survey Administration and Data Analysis

The survey was administered over 3 weeks in January, 2018 via face-to-face interviews. The questions were based on:

- Awareness of climate change
- Knowledge of coastal ecosystems
- Perception of the impact of weather changes on coastal ecosystems

- Knowledge of Marine Protected Areas
- Attitude to weather changes
- Responses to weather changes
- Education and sources of information

Written consent was secured from all participants prior to participation in the survey. A written introduction of the study, rights to withdraw, use of the data and contact information for the Lead Consultant and the Institutional Review Board (IRB) were provided for each participant before providing consent to participate.

The responses were written on the questionnaire. Each participant was assigned an identification number that was also used in data entry and analysis. The data was entered into an Excel worksheet and exported into SPSS (V.24) for analysis.

3. Results

3.1. Response Rate and Profile of the Participants

A total of 221 participants were contacted and responded to the survey. A slightly higher percentage of males participated in the study, 123 (55.7%), as compared to females, 98 (44.3%). The majority of respondents were in the age groups 26 - 35 (50, 22.6%) and 36 - 45 years (49, 22.2%). Less than 15% of respondents were in each of the other age group categories.

An almost equal percentage of respondents reported that they lived about a 1/4 mile or less from the coastline (103, 46.6%) and more than 1/4 mile from the coastline (105, 47.5%). A small number of respondents, 13 (5.9%) did not report on the distance they lived from the coastline. Almost three-quarter of the respondents, 159 (71.9%), reported that their houses were not insured. The majority of respondents, 80 (36.2%) stated their houses were constructed of wood and concrete. About 90% of households had 1 - 4 residents (adults only or adults and children). Table 1 shows the demographic characteristics of the respondents.

Disaggregated by parish, 76 (34.4%) of the respondents lived in St. Mark, which included 41 (33.3%) male respondents and 35 (35.6%) female respondents. A total of 145 (65.6%) respondents resided in St. John, which included 82 (66.7%) male respondents and 63 (64.3%) female respondents. Based on the CSO population estimates in 2016, Table 2 shows that the proportion of respondents in the survey, disaggregated by parish and gender, was similar to the general population in the two parishes.

3.2. Involvement in Activities Related to the Coastal Ecosystem

About one-quarter of the respondents, 61 (27.6%), reported they were directly involved in marine or freshwater activities, of which the majority, 50 (82.0%), were involved in fishing (Figure 1). Of the 50 respondents that reported they were involved in fishing, 34 (68.0%) also stated they were members of a fishermen organization. The result from chi-square analysis found statistically significant relationships between parish of residence and membership in a fishermen's organization (X^2 (1, N = 180) = 5.98, p = 0.01), with fishers residing in St. John's

Table 1. Demographic characteristics of the respondents.

	Number	Percent		Number	Percent
Gender			**Residence in the Parish**		
Male	123	55.7	1 - 5 years	3	1.4
Female	98	44.3	>5 years	218	98.6
Total	221	100.0	Total	221	100.0
Age Group			**Education**		
18 - 25	31	14.0	Lower than primary school	13	5.9
26 - 35	50	22.6	Primary School	80	36.2
36 - 45	49	22.2	Secondary School	79	35.7
46 - 55	38	17.2	Vocational/Trade school	11	5.0
56 - 65	25	11.3	Community College	27	12.2
≥66	28	12.7	University	11	5.0
Total	221	100.0	Total	221	100.0
Employment			**Employment Status**		
Unemployed	74	33.5	Employed full-time	63	46.3
Employed	136	61.5	Employed part-time	23	16.9
Student	8	3.6	Self-employed full-time	37	27.2
No response	3	1.4	Self-employed part-time	5	3.7
Total	221	100.0	No response	8	5.9
			Total	136	100
Primary Type of Employment			**Size of Household**		
Business	31	22.8	1 - 4 adults	196	88.7
Public service	25	18.4	5 - 10 adults	16	7.2
Construction	13	9.6	Missing	9	4.1
Agriculture	11	8.1	Total	221	100
Factory	3	2.2	1 - 4 children	203	91.9
Fishing	33	24.3	5 - 10 children	11	5.0
Other	7	5.1	No response	7	3.1
No response	13	9.6	Total	221	100
Total	136	100.0			
House Insurance			**Type of Construction Material**		
Yes	44	19.9	Concrete	72	32.6
No	159	71.9	Wood	66	29.9
No response	18	8.1	Concrete and wood	80	36.2
Total	221	100.0	Other	1	.5
			No response	2	.9
			Total	221	100.0

Table 2. Comparison of the percentage of respondents in the survey and in the general population in the parishes.

	Parish Population		Percentage of Parish Population by Gender		Percentage of Respondents in Parish by Gender	
	St. Mark	St. John	St. Mark	St. John	St. Mark	St. John
Male	2372	4523	17.8	34.0	18.6	37.1
Female	2160	4242	16.2	31.9	15.8	28.5
Total Population	4532	8765	34.1	65.9	34.4	65.6

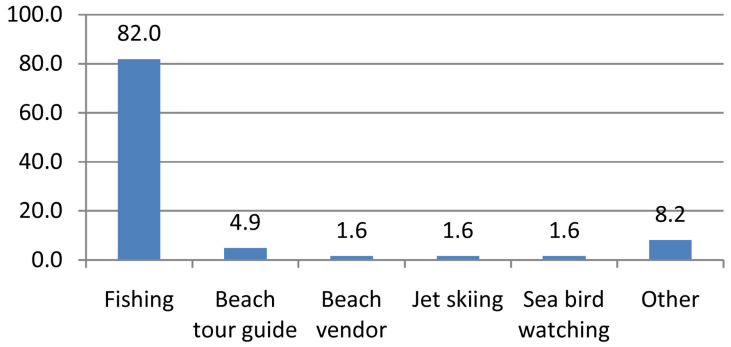

Figure 1. Percentage of respondents involved in various marine-related activities.

more likely to report being a member of an association than those residing in St. Mark's. A significant relationship was also found between gender and reporting membership in a fishermen's organization (X^2 (1, N = 180) = 14.41, $p \leq 0.1$), with males more likely to report being a member of an association than females. A statistically significant relationship was not found between age and education, respectively, and reporting membership in an association. Among the 61 respondents that reported they were involved in marine or freshwater activities, 49 (80.3%) stated they did so for 5 - 7 days per week and 40 stated for 1 - 4 days per week.

3.3. Awareness of Climate Change

The majority of respondents, 199 (90.0%) stated that they had observed changes in the weather pattern while 20 (9.0%) stated they did not observe changes. Increased rainfall was the most frequently reported observed change in the weather (157, 71.0%). Warmer weather was reported by 70 (31.7%) respondents, flooding by 57 (25.8%), less predictable rainfall by 55 (24.9%) and more hurricanes/storms by 54 (24.4%). **Figure 2** shows the percentage of respondents that reported observed changes in the weather.

When asked how informed respondents felt they were about causes and impacts and measures to mitigate the impacts of climate change, 97 (44.7%) stated they were "somewhat informed" about causes and 125 (52.6%) stated they were

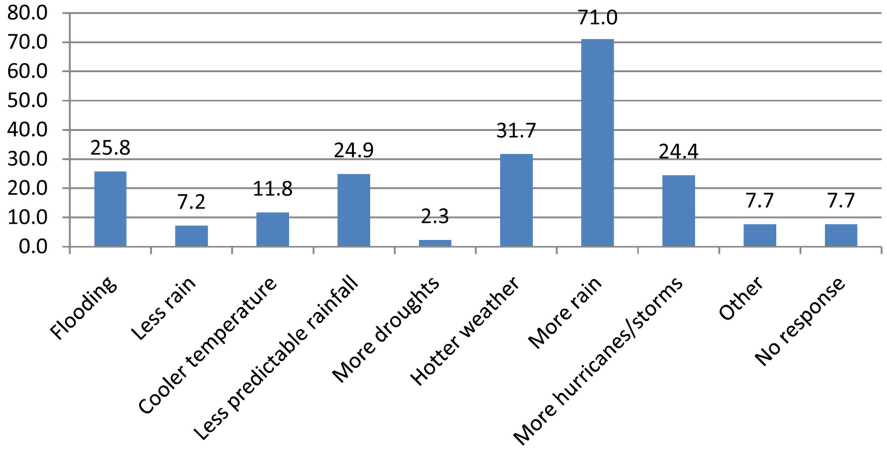

Figure 2. Percentage of respondents that observed various changes in the weather.

"somewhat informed" about impacts and mitigation measures. Almost half, 100 (45.2%), of the respondents stated that climate change was caused both by the acts of God and man, while about quarter, 58 (26.2%) felt that the phenomenon is primarily caused by man, 41 (18.6%) respondents felt it was caused by God and 17 (7.7%) were unsure of the cause.

More than half of the respondents, 122 (55.2%), stated they were very concerned about climate change while 61 (27.6%) respondents stated they were somewhat concerned. A total of 35 (15.8%) of respondents reported they were either not concerned at all or uncertain about whether they were concerned. The results from a chi-square test found that age was associated with the level of concern by respondents about climate change (X^2 (1, N = 218) = 8.00, $p < 0.01$). Respondents aged 18 - 45 years were more likely to report either being "very concerned" or "somewhat concerned" while respondents aged 46 years and older were more likely to report "not concerned at all" or "don't know/not sure" about their level of concern. Among 98 respondents that were involved in marine and freshwater activities, the majority, 60 (61.2%), felt that climate change was an important issue for their livelihood, 14, (14.3%) felt it was somewhat important and 24 (24.5%) felt the issue was not important or was uncertain about the importance to their livelihood.

Among 132 respondents that resided in a community that was bordered by the coastline, 97 (73.5%) felt that climate change was an important issue for the community, 17 (12.9) felt the issue was somewhat important, 4 (3.0%) felt the issue was not important at all and 10 (14.6%) were unsure if the issue was important for the community.

3.4. Knowledge of Coastal Ecosystem

When asked about living and non-living things that comprised the coastal ecosystem, respondents most frequently identified fishes and marine creatures, 136 (61.5%), and coral reef, 93 (42.1%). Coastal lagoon was identified by 37 (16.7%) respondents, beach vegetation by 44 (19.9%) and rivers and streams by 60

(27.1%).

Most of the respondents stated that the coastal ecosystem was beneficial for food 86 (38.9%), clean water, 52 (23.5%) and income, 48 (21.7%) (Figure 3). Few respondents stated protection from storms (19, 8.6%) and health and well being (23, 10.4%) were benefits of the coastal ecosystem.

Respondents demonstrated inconsistency in their level of knowledge about the linkages between the components of the ecosystems in stating whether statements were true or false. Table 3 shows the frequency of respondents that responded correctly to the statements. Over 70% of respondents demonstrated knowledge about coral reefs protecting the land from sea waves as well as coral reefs and mangroves as breeding sites for fishes. The lowest level of knowledge was demonstrated in relation to the function of seagrass, vegetation on river banks and mangroves.

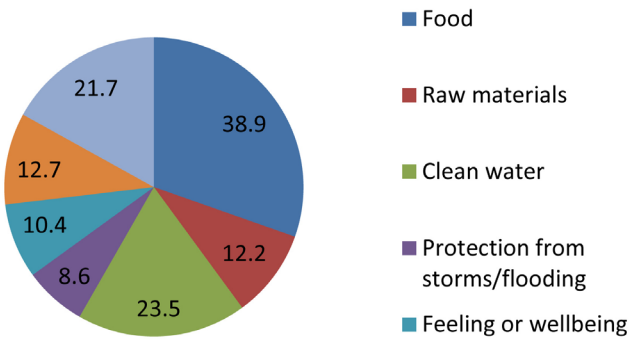

Figure 3. Respondents stated benefits of the coastal ecosystem.

Table 3. Respondents that correctly responded to statements about coastal ecosystems.

	Number	Percent
Coral reefs protect the quality of the sea water	143	64.7
Mangroves contribute to the income of fishermen	136	61.5
Without mangroves the quality of the sea water will deteriorate	106	48.0
Coral reefs protect the coastal areas from sea waves	155	70.1
Without seagrass the quality of the sea water will deteriorate	115	52.0
Without mangroves there will be fewer fishes	142	64.3
Without seagrass there will be fewer fishes	141	63.8
Without coral reefs there would be fewer fishes	159	71.9
Mangroves protect the coastal areas from sea waves	142	64.3
Coral reefs contribute to the income of fishermen	158	71.5
Without mangroves there will be fewer marine animals	137	62.0
Mangroves provide a source of food for marine organisms	149	67.4
Mangroves purify air and water	100	45.2
Seagrass helps to stabilize beaches	122	55.2
Mangroves serve as breeding site for marine animals/fishes	158	71.5
Vegetation on river banks purifies the water	99	44.8
Vegetation on river banks stabilizes the soil	147	66.5
Vegetation on river banks provides breeding sites for river species	141	63.8

Respondents most frequently reported that they noticed changes in the stock of fish/marine creatures, 122 (55.2%), beaches 104 (47.1%) and rivers/streams, 96 (43.4%). Less than one-third of the respondents reported they noticed changes in the seagrass (66, 29.9%), corals (51, 23.1%), beach vegetation (56, 25.3%), mangroves (34, 15.4%), and coastal lagoons (32, 14.5%). More than one-quarter of the respondents, 63 (28.5%), also reported that they did not notice any change in the coastal ecosystem.

3.5. Perception of the Impact of Climate Change on Coastal Ecosystem

Respondents who resided in coastal areas were asked about their perception of how climate change may have affected their household or their community. Among 163 respondents, 83 (50.9%) stated they believed their household income was affected by climate change, 75 (46.0%) believed their household finances were impacted, 72 (44.2%) believed the health of one or more household member was impacted, 76 (46.6%) believed their house or property infrastructure was impacted. On the other hand, 49 (30.1%) respondents stated that do not believe their household was impacted in any way and 2 (1.2%) respondents stated they were unsure.

Figures 4-6 show the percentage of respondents that correctly identified factors that affect coral reefs, mangroves and fish reproduction, respectively. Respondents demonstrated the highest level of knowledge about high sea temperatures (74, 33.5%), storm surge/sea level rise (68, 30.8%) and water pollution (63, 28.3%), as factors that can negatively affect coral reefs. Respondents demonstrated the least knowledge about the effects of reduced light intensity (22, 10.0%), algal growth (25, 12.0%) and sedimentation on the coral reefs (32, 14.5%).

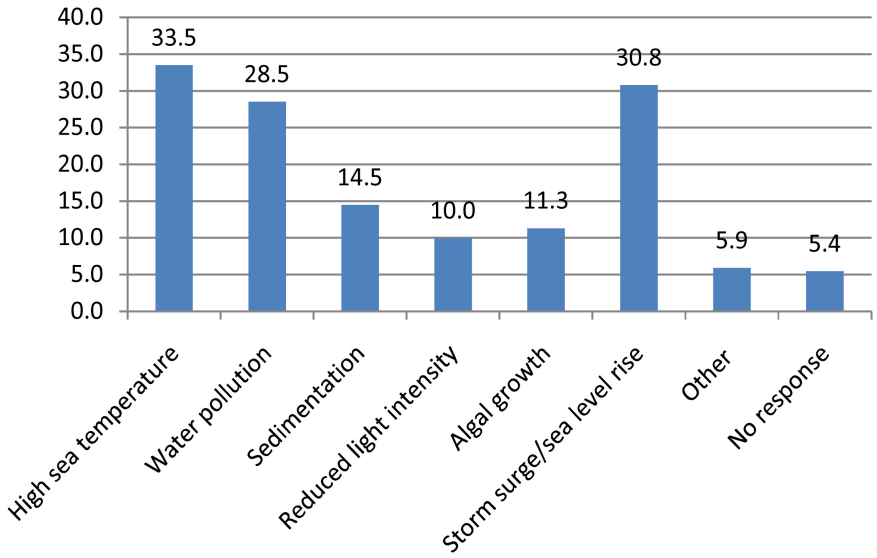

Figure 4. Respondents that correctly identified factors that negatively affect coral reefs.

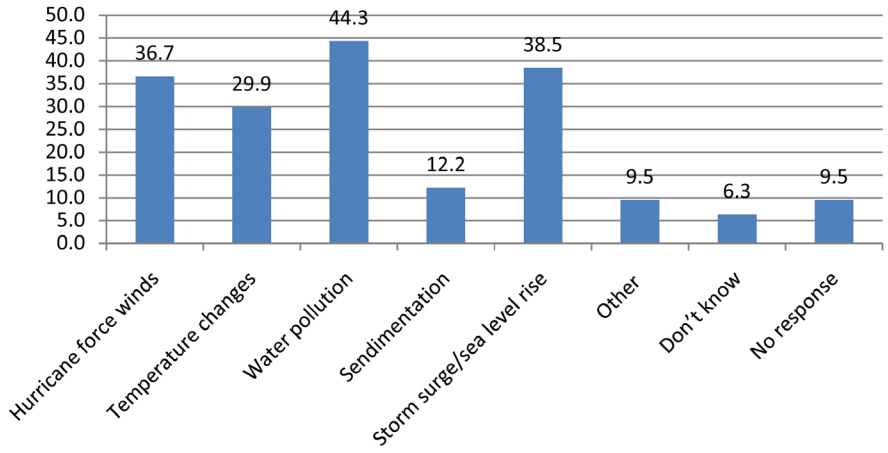

Figure 5. Respondents that correctly identified factors that negatively affect mangroves.

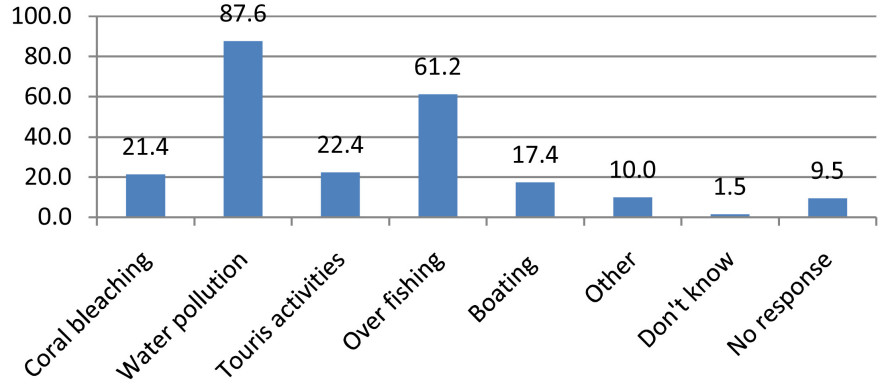

Figure 6. Respondents that correctly identified factors that negatively affect fish reproduction.

3.6. Attitude to Climate Change and Coastal Ecosystem

The highest number of respondents, 56 (25.5%), reported they felt confused about climate change, while 49 (22.3%) stated they were fearful or hopeful, respectively (**Figure 7**). Less than 10% of respondents expressed that they either felt sad, angry or powerless and 15% said they were uncertain of their feelings about the issue. When asked who was mainly responsible for addressing climate change, half of the respondents, 110 (50.7%), felt it should be a joint effort between government, businesses, community organizations, industrialized countries, the United Nations and individuals. A smaller percentage, 49 (22.6%), felt that the local government was mainly responsible for addressing the problem and 18 (8.3%) felt that individuals were mainly responsible.

The majority of respondents, 187 (84.6%) agreed that the Government should play a more leading role in addressing the impacts of climate change on communities. Nonetheless, only about half of the respondents, 120 (54.3%) also stated they were willing to make additional financial contributions or put up with some inconvenience to help preserve the environment. The majority, 136 (61.5%) agreed that, although Grenada was a small country, actions can be taken

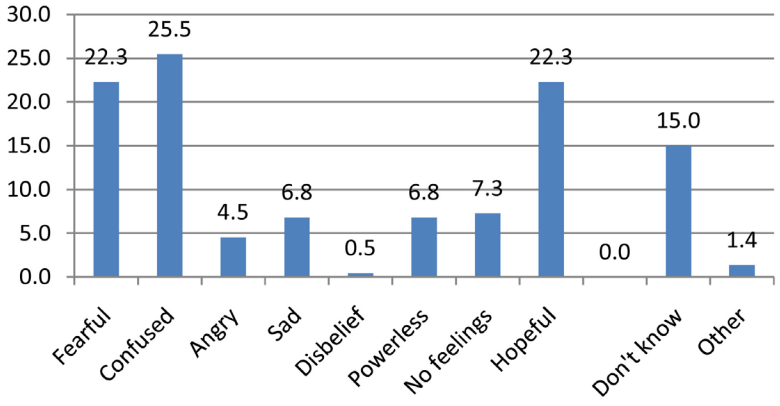

Figure 7. Respondents feelings about climate change.

to address the problem. While 109 (49.3%) agreed that Grenada should play a leading role in addressing climate change in the Caribbean region, an almost equal percentage of respondents, 94 (42.5%), were neutral.

About half of the respondents, 111 (50.2%), also felt that individuals were in a position to act while more than a quarter, 64 (29.0%), were neutral and 145 (67.8%) stated they wished for more opportunities to take practical actions to address the issue.

Only 22 (10.0%) of the respondents reported that they read, listened, or watched information frequently about climate change while more than one third either did so occasionally (76, 34.4%) and 68 (30.8%) did so infrequently. The results from a chi-square test do not show a statistically significant difference in responses by gender, age, parish of residence and education ($p > 0.05$). Respondents stated the most common sources of information on climate change were radio/television (165, 74.7%), internet (81, 36.7%) and neighbours (61, 27.6%).

3.7. Response to Climate Change and Coastal Ecosystem Management

Figure 8 shows the overwhelming majority of respondents, 202 (91.4%), reported they did not take any action to mitigate the impacts of climate change on the coastal ecosystem in the past 5 years.

The results from a chi-square test found there was an association between age and reporting haven taken action to mitigate the impacts of climate change on the ecosystem (X^2 (1, N = 217) = 4.56, p = 0.03). Respondents in the age groups of 46 years and over were more likely to report having taken action to mitigate the impacts of climate change on the ecosystem. A statistically significant relationship was also found between education and reporting having taken action to mitigate the impacts of climate change on the ecosystem (X^2 (1, N = 217) = 14.32, $p < 0.01$). Respondents that completed education at college or university level were more likely to report having taken actions to reduce the effects on the ecosystem.

More than 50% of 126 respondents stated that the three most important actions

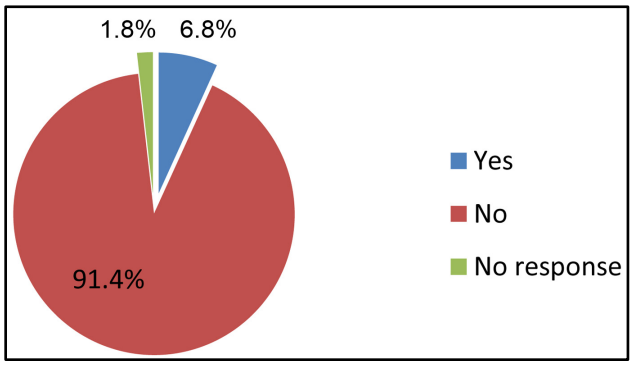

Figure 8. Respondents self-reported action to mitigate the impacts of climate change on coastal ecosystem.

that should be taken to address climate change are public education, reduced pollution, and establishment and enforcement of laws for resource management.

When asked what may have prevented the community from taking action in regard to climate change, at least 50% of 138 respondents stated that the community lacked knowledge about the issue, resources to address the issue and there was a lack of cooperation among the residents.

3.8. Knowledge and Support for Marine Protected Areas

More than one-third of the respondents, 88 (39.8%), reported they were familiar with the term "marine protected area." More than half of the respondents, 129 (58.4%), however, also stated they were not familiar with the term. When asked to describe the term, respondents correctly alluded to the designation of an area for protection of the environment and resources such as fishes, coral and other marine life.

With regard to knowledge about MPAs in Grenada, 98 (44.8%) reported that they knew of other MPAs while an almost equal percentage of respondents, 93 (42.1%) reported they were not aware of other MPAs in the country.

3.9. Education and Awareness

The overwhelming majority of respondents, 207 (93.7%) stated that they did not participate in any programmes to raise awareness about climate change in the past 5 years while 10 (4.5%) of the respondents stated they had participated in such programmes (**Figure 9**). Those who participated in programmes stated they did so at a forum in Victoria, while on a tour to the reefs, in a programme with the Ministry of Agriculture, in a forum at Gouyave Fish Market, and while participating in a cleanup drive.

A similarly large percentage of respondents, 194 (87.8%), stated they did not participate in any programmes to raise awareness about coastal ecosystem management in the past 5 years (**Figure 10**). Those who participated in programmes stated they did so at a forum with the Ministry of Agriculture, work-related and a session upstairs the Gouyave Fish Market.

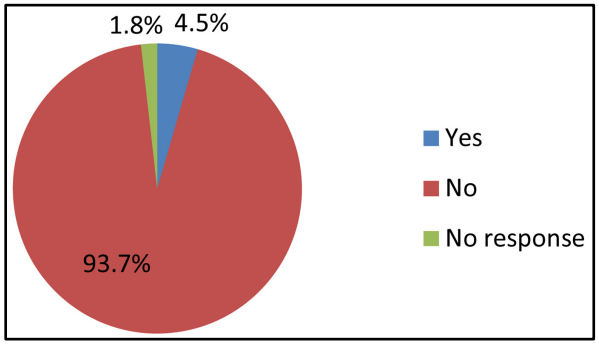

Figure 9. Respondents participation in climate change awareness programmes in the past 5 years.

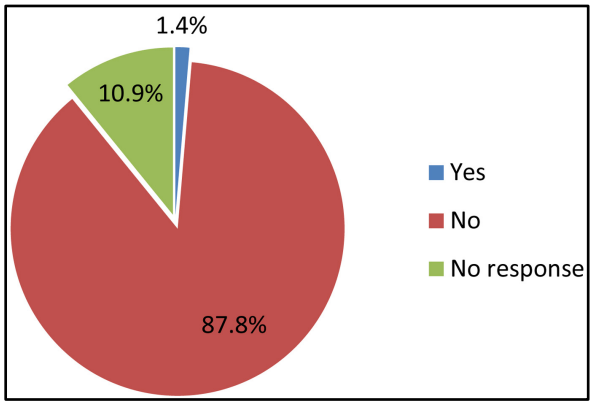

Figure 10. Respondents participation in programmes to raise awareness about coastal ecosystem.

4. Discussion

Prior to this study, two studies were conducted with residents in Grenada to related coastal and marine ecosystems. The Evaluation of Socio-economic Conditions and Environmental Interactions on a Section of the East Coast of Grenada was conducted in 2008 as part of the regional project socio-economic monitoring by Caribbean Fisheries Authorities, funded by a US Coral Reef Conservation grant, and jointly coordinated with the Center for Resource Management and Environmental Studies (CERMES) of the University of the West Indies, Cave Hill Campus, Barbados [4]. The findings show that coastal and marine resources were highly utilized. The residents were knowledgeable about unsustainable practices and laws to address those practices; however, community participation and monitoring of the resources were lacking. In 2016, an islandwide Climate Change Awareness Survey was also conducted, supported by the UNDP-JCCCP [5]. The report shows that many residents were aware of changes in the weather pattern, and regarded the experience as a serious issue. Nonetheless, the study also found that there were gaps in the level of knowledge about climate change and behaviors that contribute to the problem. The findings in the two studies indicate the need for continuous assessment of knowledge, practices and attitudes as well as appropriate interventions to help residents.

The results of this study were, generally, consistent with the findings of the two previous studies conducted by Fontenard [5] and Isaac [4] showing that knowledge and practices related to climate change and coastal ecosystem management were, in many regards, limited and there is a need to increase awareness about climate change and its impacts as well as to strengthen measures for coastal and marine resource management. The findings of this study with residents on the western side of the island indicate many similarities to the findings in the study by Isaac [5] on the eastern side of the island focusing on knowledge and practices related to coastal and marine ecosystems. In both studies, it was found that, generally, between a quarter to half of the residents noticed changes in the coastal and marine environments that may be indicative of climate change impacts. Isaac indicated, however, there were contradictions in some responses, such as, in finding that coral reefs were in good/very good conditions while the fish stock was in a bad/very bad condition. In the study in St. John and St. Mark, there was a similar pattern of inconsistency in observation of changes in the environment with almost half of the respondents reporting changes in stock of fish/marine creatures, beaches, and rivers/streams, respectively, while only about one quarter reporting observed changes seagrass, corals, mangroves, and coastal lagoons. In a report by Day, the degradable condition of the corals and mangroves in Grenada were noted although it did not appear that residents were aware. Instead, the changes that were noted by the residents may indicate they were more aware of what was obvious or had more meaning or impact on their livelihood and survival, such as availability of fish for food and the condition of beaches for recreation, rather than an indication of keen attention to their general environment.

Some residents in this study were able to make connections between the state of the coastal and marine environments and changes in the weather. In the study with residents on the eastern side of the island, climate change was not mentioned as a possible cause of the changes in the environment. Sand mining was felt to have the greatest impacts on coastal and marine environments [4]. This result may be due to the closed-ended questions that did not allow for an indication of climate change or a lack of awareness about the potential impact of climate change and on environmental resources. In the study in the westerly parishes, overwhelmingly, fewer than 70% of residents correctly identified statements about the coastal ecosystem. Fontenard also reported that few residents felt climate change was among the most serious issues in Grenada and the Caribbean [5]. The three studies emphasize the need for urgent attention to increase knowledge about climate change and adaptation in Grenada especially give the current and potential impacts on small island states already evidenced in Grenada and other Caribbean countries.

The results of this study show mixed feelings about climate change with about one-quarter of respondents, respectively, reporting they felt confused, fearful, and hopeful about the issue. Similarly, Fontenard also reported there were un-

certainties about how participants felt about climate change with more than half (53.0%) saying that they needed more information [5]. Few respondents felt that they were "very well informed" of issues related to climate change with less than a quarter indicating not knowing enough regarding issues such as the cause and possible effects of climate change, or what could be done to reduce climate change and protect themselves from it [[4], p. 7]. Similarly, the studies that were conducted in St. Lucia, Belize and Jamaica also show inconsistency in knowledge and practices related to climate change and/or management of coastal resources [6] [7] [8] [9].

The majority of respondents stated they observed changes in the weather pattern. While at least 50% of the respondents correctly identified factors that can contribute to those changes, the majority, nonetheless, also reported they were only "somewhat informed" about the causes and impacts and measures to mitigate the impacts of climate change. On average, about 90% of respondents reported that, in the past 5 years, they did not participate in any programmes to raise awareness about climate change or about coastal ecosystem management. There were several initiatives in Grenada to raise awareness about climate change, such as programmes by the National Disaster Management Agency (NADMA) on climate change resilience, the World Bank, Food and Agriculture Organization (FAO), the Ministry of Agriculture and The Nature Conversancy (TNC). A Ministry has also been designated to address climate change matters. However, only a few programmes may have been conducted in St. John and St. Mark, especially over the last seven years. Fontenard reported that 42.5% of residents stated they were aware of organizations dealing with climate change in Grenada [5]. Nonetheless, there was an indication of low participation in the programmes by the residents in the westerly parishes which may be related to the level of participation may be related to the low concerns about the issue of impacting livelihood and routine activities. Efforts should be made to address this issue with particular targeting of the residents in sustained community-based programmes. Television programmes may be given preference in education campaigns given Fontenard [5] reported 84.2% of the residents had a preference for receiving information through that medium. Using an ecosystem-based approach may also be best to also heighten awareness about the connectivity and value of each part of the environment. Residents who completed less than college level education, residents above 45 years and residents in St. Mark should be specially targeted to participate in such initiative. Albeit, the level of participation and impact of such programmes will need to be assessed to ensure that the objectives can be achieved.

The communication plan should be developed with clearly defined strategies to reach different groups—such as, farmers, young people, business owners, individuals with low academic skills, etc.—and to receive feedback. Using a variety of media will also ensure that information is disseminated to the widest cross-section of the public. Regular ongoing face-to-face engagements can also be essential to mobilize interest and support for the MPA project.

The vulnerability of coastal communities in Grenada and the urgency for action was highlighted by Day [2]. Day stated, "*Grenada's coastal communities are particularly at risk from the combined hazards of sea level rise and intensifying storms*, *which present real and increasing threats to human life and infrastructure in low-lying areas. These hazards are greatly exacerbated by the degraded condition of many of Grenada's coastal ecosystems*, *particularly mangroves and coral reefs*, *which*, *in a healthy state*, *can provide effective barriers for coastal protection and disaster risk reduction*" [[2], p.72]. The results from the focus groups indicate that community residents, in general, were less knowledgeable about climate change and coastal ecosystems than students and fishers, but the group also demonstrated the most willingness to learn about the issues and to take actions. A suggestion was made to form a community action group. GRENCODA should leverage this interest to galvanize support and participation in the MPA project. This may also contribute to the residents' ownership of and responsibility for managing the community resources beyond the lifetime of the project.

Almost half of the respondents reported that they were somewhat concerned, not concerned at all or not sure if they were concerned about climate change. This represents a fairly significant proportion of respondents and may indicate a likelihood of indifference towards community initiatives to address the problems, particularly by older individuals (above 45 years). As such, careful consideration should be given to the design and implementation of the MPA project to attract high participation and interest.

Previous studies by Isaac and Fontenard and this study show the need to increase climate change education and awareness in Grenada. The potential positive results of education programmes are reflected in studies in Cambodia that show significant changes in understanding the causes and effects of climate change and how daily activities can contribute to climate change [10]. Implementation of education and adaptation programmes that link routine activities and livelihood to climate change in both directions may be most effective to improve knowledge and practices to reduce and mitigate climate change impacts [10]. A study in Belize also shows a low appreciation for MPAs can be as a result of low knowledge about climate change [6]. This is significant for the context of the GRENCODA project for which community support and participation is crucial. Many respondents were not familiar with MPAs in Grenada which may also indicate limited knowledge and awareness about the national measures to protect the marine resources.

Day [2] further recommended that the Marine Protected Areas (MPAs) in Grenada be aligned with ecosystem-based adaptation. This approach would require measures to restock decreased stock. This approach requires an entrenchment of protection and restoration of resources as well as ecological resilience [2]. The results of this study may indicate that establishing a relationship to livelihood may be the most important factor for participation and cooperation in MPA projects. Consequently, the MPA project which would require a response

of better stewardship by stakeholders should also answer the basic question, "What is in it for me?" being sensitive to the fact that several practices observed are related to livelihood issues. For example, stones that are washed onto the beaches are gathered and sold by persons whose preoccupation is generating income to sustain themselves or family. Considerations of long-term impact on the beach take second place even when it may be observed that the coastline is changing.

The following considerations can be taken on board in framing the response:

- Establish and nurture a close relationship with the Grenada Fisheries Division, under whose jurisdiction MPAs will fall to keep them informed of plans and benefit from their technical expertise, policy and legal guidance, or material resource inputs for any interventions undertaken.
- Review and draw on best practices and lessons learned in the management of other MPAs in Grenada. This should lead to a quicker startup and implementation as well as reduce the cost associated with trials and formative research.
- Target community persons to be the beneficiary of positions that reward services rendered with pay, as much as possible. For example, young people in the community can be hired to operate/maintain watercrafts, affording a prolonged interest in the project beyond the education campaign.
- Emphasize the use of indigenous resources to create a cycle of benefit. For example, specials boats may be constructed to provide tours to reefs with the aim of heightening awareness about the local resources while promoting livelihood. The crafts can also be used to patrol and monitor the MPA.
- For sustainability, it may be advantageous to build a livelihood component into the MPA project to keep an interest in protecting the area even after the lifetime of the project. For instance, if the project targets the restoration of coastal reefs: introduce the planting and harvesting of seamoss (*i.e.* macroalgae of the genus Gracilaria) as a livelihood activity for which stakeholders would have an economic incentive to keep the reefs healthy.
- A partnership should be formed with the Ministry of Agriculture to implement the training in schools with the climate change education kits. Their use and effectiveness may also be assessed in the context of the suitability for wider community education initiatives.
- The use of climate change education kits can be extended to the community education programmes.

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Conflicts of Interest

The authors declare no conflict of interest.

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