Integrating digital technologies and participatory tools to support coastal community resilience in Trinidad & Tobago (Tech4CoastalResilience)


# Moruga Community Resilience Plan

April 4, 2025

**Acknowledgements**

CANARI would like to thank the Fisheries Division, Ministry of Agriculture, Land and Fisheries for their support in conducting action planning in Moruga, Trinidad, as well as the community and other key stakeholders from the public and private sector for generously giving of their time and sharing their knowledge and perspectives, to develop this community resilience plan.

**Citation:** Granderson, A., Ramkissoon, C., Khan, K., and Thanoo, A. 2025. Moruga Community Resilience Plan. Prepared under the Tech4CoastalResilience project. CANARI, Port of Spain.

**Cover photo:** Fisherman at Old Moruga Fishing Facility, Credit Candice Ramkissoon 2021

## 1. Overview

The Moruga Community Resilience Plan aims to guide coastal planning and resilience actions and identify ways to reduce vulnerability and adapt to climate change and other coastal changes in Moruga, Trinidad. It is based on the key findings from the vulnerability and capacity assessment in Moruga completed in 2021 and the inputs from community residents and other key stakeholders from an action planning workshop in 2024.

The Plan has been developed under the "Integrating digital technologies and participatory tools to support coastal community resilience in Trinidad and Tobago (Tech4CoastalResilience)" project, which is being implemented from 2023-2025 by the Caribbean Natural Resources Institute (CANARI) in partnership with the Fisheries Division, Ministry of Agriculture, Land and Fisheries and the Department of Marine Resources and Fisheries, Tobago House of Assembly. The project aims to improve the resilience of vulnerable coastal communities to climate change impacts in Trinidad and Tobago (T&T). It is supported by the "Harnessing Innovative Technologies to Support Resilient Settlements on the Coastal Zones of the Caribbean (HIT RESET Caribbean)" programme. HIT RESET Caribbean is funded by the ACP Innovation Fund implemented by the Organization of African, Caribbean and Pacific States (OACPS) and European Union (EU).

## 2. Approach and methodology

The process to develop the Plan was facilitated by CANARI and the Fisheries Division, Ministry of Agriculture, Land and Fisheries. It was designed to be interactive and participatory, engaging the community in practical exercises and discussions to support action planning for coastal resilience. See Appendix 1 for the agenda for the Moruga Community Action Planning workshop.

The process engaged fisherfolk, other coastal resource users and community-based organisations (CBOs), including the Grand Chemin Fishing Association and Moruga/La Ruffin Fishing Association, Basseterre Women's Group and the village council in Moruga, as well as key government agencies including the Institute of Marine Affairs, Coastal Protection Unit and Office of Disaster Preparedness and Management. See Appendix 2 for the list of participants.

The Plan is based on findings from the vulnerability and capacity assessment in Moruga completed in 2021. The assessment involved desk review and community scoping, participatory mapping and geographic information systems (GIS), household surveys and development of an impact and capacity matrix to collect data and better understand local impacts from climate change and other issues affecting the coast. The findings were further reviewed and validated as part of the action planning workshop in 2024. See Appendix 3 for the vulnerability and capacity assessment findings and summary poster here.

## 3. Priorities for Action

A range of actions to adapt and build coastal resilience have been identified as part of the Plan (see section 5 and Appendix 4 for further details). In particular, key climate-related impacts from coastal erosion and loss of access to beaches, mass sargassum influxes, damage to coastal property/ infrastructure and declining abundance of fish species in nearshore areas have been highlighted by participants. The following priorities for action were therefore identified for Moruga in the short to medium term (1-6 years):

- Regular beach clean ups to avoid pile-up of large amounts of sargassum at affected beaches
- Breakwater for coastal protection that is strategically placed to allow boat access, focusing on highly eroding sites such as Grand Chemin, La Retraite, La Lune and Morne Diablo

- Restoration of mangroves and other coastal vegetation along affected beaches and eroding cliffs for coastal protection
- Improved coastal monitoring to inform planning and responses
- Increased use of rainwater harvesting and water-efficient systems for households, schools and essential services to address water shortages
- Emergency shelters upgraded and increased to cater for persons displaced by extreme weather events
- Improved insurance access for property owners and for fishers, their boats, engines and gear
- Flood lights at new Moruga fishing facility and other strategic locations to attract feed (e.g. algae) and increase fish abundance in nearshore areas
- Awareness raising among fisherfolk on sustainable fishing practices (e.g. harvest rates, vessel speed and anchoring)
- Diversification of livelihoods for fisherfolk and other coastal resource users (e.g. fish and fish waste processing to produce value-added products, apiculture, aquaculture, mariculture and collection and use of sargassum), including training and provision of equipment/materials

Prioritisation was based on the level of impact or risk to the community that the action can address, whether it benefits multiple sectors and community needs, and whether it can be implemented in the short to medium term.

**The following priorities for action were selected as feasible options for further support under Tech4CoastalResilience and other current projects given the available timeframe and budget: regular beach clean ups to avoid pile-up of large amounts of sargassum; flood lights at the new Moruga fishing facility and other strategic locations to attract feed and increase fish abundance in nearshore areas; and diversification of livelihoods for fisherfolk and other coastal resource users, particularly fish and fish waste processing to produce value-added products and apiculture.** CANARI and the Fisheries Division will follow up to refine and implement one of these options.

## 4. Use of this Plan

This Plan serves as a guide for coastal planning and resilience actions in the Moruga community. It should be used and further operationalised by key government agencies, including the Coastal Protection Unit, Fisheries Division, Institute of Marine Affairs, Office of Disaster Preparedness and Management and Princes Town Regional Corporation, CBOs and residents in Moruga and relevant civil society organisations to inform efforts to address climate change and other coastal changes.

It is also aligned with, and contributes to, the National Adaptation Plan and Integrated Coastal Zone Management Policy Framework for Trinidad and Tobago.

Figure 1: Participants at the Moruga Action Planning Workshop (Source: CANARI 2024)


## 5. Summary of Moruga Community Resilience Plan

Note the table below includes only the key climate-related impacts and priorities for action identified and highlighted by participants. The full list of all the identified impacts and actions is in Appendix 4.

** = top priorities

| Community impacts and risks | Vulnerable areas and groups | Actions to adapt/build resilience | Roles and responsibilities (Lead/supporting actors) | Required resources | Time frame | Indicators of Success |
|---|---|---|---|---|---|---|
| **Coastal ecosystems and infrastructure** | | | | | | |
| <u>Sargassum influxes</u><br><br>Impacts:<br>- Major influxes on beach are unsightly and rotting sargassum has strong odour (hydrogen sulphide gas)<br>- Damage to electronic equipment and machinery (e.g. corrosion of copper) from hydrogen sulphide gas<br>- Risk of spreading new invasive species in | Vulnerable areas:<br>- Grand Chemin<br>- La Retraite<br>- La Lune<br>- Morne Diablo<br><br>Vulnerable groups:<br>- Fisherfolk<br>- Beachgoers<br>- Elderly, infants and others who suffer from respiratory diseases<br>- Households living near coast | - **Regular beach clean ups to avoid pile-up of large amounts of sargassum<br>- Preventative measures to reduce damage to electronic equipment and machinery<br>- Improved monitoring to inform response | - National Sargassum Taskforce (lead)<br>- Princes Town Regional Corporation<br>- Institute of Marine Affairs (IMA) and Environmental Management Authority (EMA) / Ministry of Planning, Economic Affairs and Development<br>- Ministry of Agriculture, Lands and Fisheries<br>- Village councils – Basseterre, La Lune and others<br>- Fisherfolk<br>- Basseterre Women's Group, Moruga Youth Development Organisation (MYDO) | - Technical expertise (marine science inc. sargassum, ecosystem restoration, climate adaptation)<br>- Financing<br>- Equipment<br>- Labour (can be provide by local community groups for clean-ups and monitoring) | Short to medium term (1-6 years) | - Reduced length of time that sargassum stranded on beach<br>- Reduced costs to households and business along coast for loss and damage of equipment and machinery<br>- Monitoring system established to detect new invasive species and alert relevant authorities |

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| sargassum mats | - Property owners along coast<br>- Vendors and tourism-related small businesses | | and other local community groups<br>- Local businesses<br>- CANARI and other NGOs<br>- University of West Indies (UWI) | | | |
| <u>Coastal erosion</u> due to sea level rise, storms and storm surge<br><br>Impacts:<br>- Beach erosion<br>- Reduced/loss of access to beaches and coastal resources for residents and visitors, impacting well-being and livelihoods<br>- Damage and loss of coastal property, infrastructure and monuments/ heritage sites | Vulnerable areas:<br>- Grand Chemin (old fishing facility in disrepair; wall of Roman Catholic Primary School undermined; statue of Saint Peter falling)<br>- La Retraite (beach inaccessible to visitors and local vendors)<br>- La Lune (fish landing site not in use due to erosion) | - **Breakwater (e.g. groynes), which is strategically placed to allow boat access, to protect high risk areas<br>- **Restoration of mangroves and coastal vegetation along beaches<br>- Improved monitoring to inform response<br>- Emergency shelters upgraded and increased to cater for displaced<br>- Building codes upgraded to reflect sea level rise and more extreme weather and enforced | - Coastal Protection Unit (CPU)/ Ministry of Works and Infrastructure (co-lead)<br>- IMA, EMA and Town & Country Planning Division, Ministry of Planning, Economic Affairs and Development (co-lead)<br>- Village councils – Basseterre, La Lune and others (co-lead)<br>- Princes Town Regional Corporation<br>- Office of Disaster Preparedness and Management (ODPM)<br>- Fisheries Division /Ministry of Agriculture, Lands and Fisheries | - Technical expertise (coastal engineering, construction) ecosystem restoration, climate adaptation)<br>- Financing (significant costs to build and maintain breakwater)<br>- Equipment<br>- Materials<br>- Seedlings for restoration<br>- Labour | Medium term (4-6 years) | - Extent of beach area remains same/ increased<br>- Improved health and extent of vegetation<br>- Reduced costs for damage, and repair or maintenance, of buildings and other coastal infrastructure |

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| | - Morne Diablo (fish landing site not in use; replaced with desalination plant)<br>- Marac, Batiment and Quasime also at risk<br><br>Vulnerable groups:<br>- Fisherfolk<br>- Beachgoers<br>- Households living near coast<br>- Property owners along coast<br>- Vendors and tourism-related small businesses | - Improved access to insurance for property owners and for fisherfolk (including boats, engines and gear) | - National Trust of Trinidad and Tobago<br>- Moruga/La Ruffin Fishing Association, Grand Chemin Fishing Association<br>- MYDO and other local community groups<br>- Property owners<br>- Insurance providers<br>- SpeSEAS, CANARI and other NGOs<br>- T&T Red Cross Society (TTRCS)<br>- UWI | | | |
| **Fisheries** | | | | | | |
| <u>Shift in ocean conditions and temperatures</u> | Vulnerable groups include:<br>- Fisherfolk | - **Construction of flood lights at new fishing | - Fisheries Division/ Ministry of Agriculture, Lands | - Technical expertise (marine science, sustainable fisheries) | Short to medium | - Increased catch and size of fish in |

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| Impacts:<br>- Decrease in abundance of certain fish species in ocean (e.g. sardines in nearshore areas, linked to loss of feed) and in mouth of Moruga river (e.g. catfish and crab)<br>- Increase in distance travelled to catch fish and fuel costs due to shifting fish distribution and migration | - Households dependent on fishing as key source of income or food<br>- Recreational fishers<br>- Tour operators (fishing charters) | facility and other strategic locations to attract feed (e.g. algae) and increase fish abundance in nearshore areas<br>- **Awareness raising among fisherfolk on sustainable fishing practices (e.g. harvest rates, vessel speed and anchoring)<br>- Adoption of fish aggregating devices (FADs) with proper use and management<br>- Shifting to other fishing areas and types of fish species<br>- Fuel subsidy/ compensation to fisherfolk to offset high fuel costs<br>- **Diversification of livelihoods for fisherfolk (e.g. fish and fish waste | and Fisheries (co-lead)<br>- Moruga/La Ruffin Fishing Association and Grand Chemin Fishing Association (co-lead)<br>- National Agricultural Marketing and Development Corporation (NAMDEVCO)<br>- Fisherfolk<br>- Basseterre Women's Group<br>- MYDO<br>- CANARI<br>- Caribbean Fisheries Training and Development Institute (CFTDI)<br>- UWI<br>- UN Food and Agriculture Organization (FAO)<br>- Caribbean Agricultural Research & Development Institute (CARDI)<br>- Inter-American Institute for | - Financing<br>- Equipment<br>- Materials<br>- Labour | term (1-6 years) | nearshore areas and Moruga river mouth<br>- Increased variety of fish species caught (including nearshore and pelagic species)<br>- Increased number of fisherfolk engaged in alternative livelihoods |

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| | | processing to produce value-added products, apiculture, aquaculture, mariculture), including training and provision of equipment/ materials | Cooperation on Agriculture (IICA) | | | |
| **Tourism** | | | | | | |
| <u>Hot, dry spells</u> with rising air temperatures<br><br>Impacts:<br>- Heat stress<br>- Water shortages and issues accessing potable water<br>- Increase in energy costs with greater use of air conditioning in guesthouses and tourism-related businesses due to heat | Vulnerable groups:<br>- Elderly persons and young children sensitive to heat and water stress<br>- Visitors<br>- Guesthouse owners<br>- Tour operators<br>- Vendors along beaches and roadsides<br>- Other tourism- | - Use of renewable energy (e.g. solar PV) to power tourism-related businesses, and for water pumps, to reduce energy costs<br>- Subsidies to address increased need for air conditioning and energy costs<br>- Increased use of water storage tanks, rainwater harvesting and water-efficient systems in | - T&T Electricity Commission (T&TEC) and WASA/ Ministry of Public Utilities (lead)<br>- Ministry of Trade, Investment and Tourism (co-lead)<br>- Guesthouse and tour operators and other tourism-related businesses (co-lead)<br>- Ministry of Energy and Energy Industries<br>- Princes Town Regional Corporation<br>- Village councils – Basseterre, La Lune and others | - Technical expertise (renewable energy, engineering, water resources management)<br>- Financing<br>- Equipment<br>- Materials<br>- Labour | Short to medium term (1-6 years) | - Reduced costs for use of air conditioning or cooling systems among tourism-related businesses<br>- Increased use of water storage tanks and rainwater harvesting among tourism-related businesses |

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| - Increase in need and costs for installing and maintaining water tanks and water-efficient appliances due to water shortages | related businesses | tourism-related businesses | - Global Water Partnership – Caribbean (GWP-C) | | | |
| **Water and health** | | | | | | |
| <u>Extreme and variable rainfall</u> leading to floods and dry spells/droughts<br><br>Impacts:<br>- Decline in availability and quality of potable water (already limited access to pipe-borne water) for households, schools and essential services (e.g. healthcare)<br>- Hygiene and sanitation issues due to limited | Vulnerable groups:<br>- Young children, elderly and persons with co-morbidities<br>- Households without pipe-borne water<br>- Local service providers and businesses without pipe-borne water | - **Increased use of rainwater harvesting and water-efficient systems for households, schools and essential services<br>- **Upgrade and increase in emergency shelters to cater for displaced<br>- Installation of solar-powered desalination plant to improve water access | - Water and Sewage Authority (WASA)/ Ministry of Public Utilities (co-lead)<br>- Princes Town Regional Corporation (co-lead)<br>- Village councils – Basseterre, La Lune and others (co-lead)<br>- EMA and Town and Country Planning Division/ Ministry of Planning, Economic Affairs and Development<br>- Ministry of Education<br>- Ministry of Health<br>- ODPM<br>- Property owners<br>- School principals | - Technical expertise (water resources management, renewable energy, engineering)<br>- Financing (significant costs to build and maintain plant)<br>- Equipment<br>- Materials<br>- Labour | Medium term (4-6 years) | Improved, regular supply of potable water to Moruga community |

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| access to potable water | | | - Local service providers<br>- GWP-C<br>- Habitat for Humanity Trinidad and Tobago<br>- TTRCS | | | |

# Appendix 1: Agenda

## Integrating digital technologies and participatory tools to support coastal community resilience in Trinidad & Tobago (Tech4CoastalResilience)

**Moruga Community Action Planning Workshop**
**June 18, 2024**

**CONCEPT NOTE**

**Background**

The project, "Integrating digital technologies and participatory tools to support coastal community resilience in Trinidad and Tobago (Tech4CoastalResilience)", is being implemented from 2023-2024 by the Caribbean Natural Resources Institute (CANARI) in partnership with the Fisheries Division, Ministry of Agriculture, Land and Fisheries and the Department of Marine Resources and Fisheries, Tobago House of Assembly. It aims to improve the resilience of vulnerable coastal communities to climate change impacts in Trinidad and Tobago (T&T). It is supported by the "Harnessing Innovative Technologies to Support Resilient Settlements on the Coastal Zones of the Caribbean (HIT RESET Caribbean)" programme. HIT RESET Caribbean is funded by the ACP Innovation Fund implemented by the Organization of African, Caribbean and Pacific States (OACPS) and European Union (EU).

CANARI, the Fisheries Division, Ministry of Agriculture, Land and Fisheries and Department of Marine Resources and Fisheries, Tobago House of Assembly are conducting action planning workshops in ten coastal communities – Blanchisseuse, Carli Bay, Icacos, Mayaro, Matelot and Moruga in Trinidad and Castara, Roxborough, Speyside and Scarborough in Tobago – from June to August 2024 under the project. These workshops will involve validating the findings from the vulnerability and capacity assessments conducted in these communities to better understand local impacts from climate change and other issues affecting the coast, and prioritising actions to build local resilience. This will inform efforts to implement specific coastal resilience actions under the project and in the future.

**Workshop goal and objectives**

The goal of this workshop is to engage community residents in Moruga and other key stakeholders to review and validate key impacts from climate change and other changes and related vulnerabilities and prioritise strategies to adapt and build coastal resilience.

The specific objectives of the workshop are to:

- review findings from the vulnerability and capacity assessment completed in 2021 in Moruga in terms of key impacts and vulnerabilities related to climate change and other changes, including for the fisheries and tourism sectors and related livelihoods;
- conduct participatory action planning to improve understanding of and identify ways to reduce vulnerability and adapt to climate and other changes; and
- prioritise specific strategies to adapt and build coastal resilience in Moruga.

**Workshop venue**

The workshop will be held June 18, 2024 from 10am–3:15pm at the Princes Town Regional Corporation Sub-Office, Grand Chemin, Moruga, Trinidad.

**Target group**

The workshop will target 20-30 participants, including fisherfolk, hotel and tour operators, other coastal resource users and community-based organisations in Moruga. The project partners and government and civil society organisations involved in fisheries, coastal and marine management, climate change and disaster risk management in Moruga will also be engaged. This includes:

- key government agencies involved in adaptation, disaster risk management and coastal and marine resource management, including Fisheries Division, Institute of Marine Affairs, Office of Disaster Preparedness and Management and the Princes Town Regional Corporation;
- civil society organisations, including fisherfolk organisations, environmental non-governmental organisations (NGOs), women's, youth and other community groups; and
- private sector, including fisherfolk and hotel and tour operators.

**Approach**

The workshop will be facilitated by CANARI in collaboration with the Fisheries Division, Ministry of Agriculture, Land and Fisheries. It will be designed to be interactive and participatory, engaging the community in practical exercises and discussions to support action planning for coastal resilience.

**Outputs**

A local action plan for building coastal resilience will be developed based on the key findings from the vulnerability and capacity assessment in Moruga and the inputs from community residents and other key stakeholders. Specific strategies to adapt and build coastal resilience in Moruga will also be identified to be further implemented under the project.

**Travel and meals**

CANARI will cover the costs of the venue and meals for all participants. Local travel to Moruga may also be covered for civil society representatives where needed.

**Provisional Agenda**

| **June 18, 2024** | |
|---|---|
| 9:30 am | Registration of participants |
| 10:00 am | Opening remarks, welcome and introductions<br>Overview of the project and workshop objectives |
| 10:45am | Presentation and Q&A – VCA findings for Moruga community<br>Group discussion – Validating VCA findings for Moruga community |
| **12:00 pm** | **Lunch** |
| 1:00 pm | Introduction to participatory scenario planning<br>Interactive exercise – Participatory Scenario Planning for Moruga community |
| 2:15 pm | Group discussion – Prioritising strategies to adapt and build coastal resilience of Moruga community |
| 3:05 pm | Wrap up and next steps for project |
| 3:10 pm | Closing remarks |
| **3:15 pm** | **End of workshop** |

**For more information, please contact CANARI via Ainka Granderson, Senior Technical Officer at ainka@canari.org or Kerresha Khan, Technical Officer at kerresha@canari.org or call 638-6062**

# Appendix 2: List of Participants

**REGISTRATION SHEET – MORUGA COMMUNITY ACTION PLANNING WORKSHOP**

June 18, 2024 | Moruga Sub-office, Princes Town Regional Corporation | 10am-3:15pm

| # | FULL NAME | ORGANISATION/ AFFILIATION | TITLE | EMAIL |
|---|---|---|---|---|
| 1 | Giselle Lewis | Basseterre Community Council | Secretary | Gisellelewis350@gmail.com |
| 2 | Christopher Alexis | Institute of Marine Affairs | Research Officer | calexis@ima.gov.tt |
| 3 | Leon Joseph | Moruga/ La Rufin Fishing Association | - | - |
| 4 | Dwayne Joseph | Moruga/ La Rufin Fishing Association | - | - |
| 5 | Nicholas Jaikaran | Moruga/ La Rufin Fishing Association | - | - |
| 6 | Casey Primus | Moruga/ La Rufin Fishing Association | - | francisprimus@gmail.com |
| 7 | Nyoka Sinanan | Coastal Protection Unit | Coastal Engineer | nysinanan@mowt.gov.tt |
| 8 | Recardo Mieux | Fisheries Division, Ministry of Agriculture, Lands and Fisheries | Fisheries Officer | rmieux@gov.tt |
| 9 | Anand Bissessar | Fisheries Division, Ministry of Agriculture, Lands and Fisheries | Fisheries Assistant | Anandbissessar579@gmail.com |
| 10 | Melissa Jittan-Gazee | Office of Disaster Preparedness and Management (ODPM) | Hazard Mitigation Assistant | mjittangazee@mns.gov.tt |
| 11 | Cassie Roopnarine | ODPM | GIS Specialist | croopnarine@mns.gov.tt |
| 12 | Randolph John | Fisheries Division, Ministry of Agriculture, Lands and Fisheries | Fisheries Assistant | randolphherbeth@gmail.com |
| 13 | Lawerance Toussaint | Grand Chemin Fishing Association | President | - |
| 14 | Ainka Granderson | Caribbean Natural Resources Institute (CANARI) | Resilience Programme Manager/ Facilitator | ainka@canari.org |
| 15 | Candice Ramkissoon | CANARI | Senior Technical Officer/ Facilitator | candice@canari.org |
| 16 | Kerresha Khan | CANARI | Technical Officer/ Facilitator | kerresha@canari.org |

# Appendix 3. Moruga Vulnerability and Capacity Assessment

## Overview of community

An overview of the Moruga community is provided below, including the community, geography, demographics, socio-economic activities, and previous assessments in the area of relevance to climate change.

| **Moruga, Trinidad** |
| --- |
| **Geography**<br>Moruga is located along the south western coastline of Trinidad and comprises communities including the Fifth Company Village, Grand Chemin, La Lune, La Retrecht, La Rufin, Marac and Rock River. The Columbus Channel lies between Moruga and the coast of Venezuela, which is about 18km away.<br>Historically, Moruga is attributed as the location where Christopher Columbus and his crew first landed in Trinidad (Thomas and Guides, 2018). It is also culturally significant as the location where the "Merikins" or African American Marines of the War of 1812 that were freed slaves established a community in Trinidad in 1815 (FAO, forthcoming).<br>The community is adjacent to the proposed Trinity Hills and Eastern Extension Protected Area (dubbed the Trinity Hills Species Management Reserve) (FAO, forthcoming), which has a mountainous, coastal cliffside that forms the southern boundary of the proposed protected area (PA). The PA and wider area have tourism potential, with its natural beauty and heritage sites such as the Moruga Spring Bridge, areas that grow Moruga Hill Rice (a unique red grain dryland rice) and the National Cocoa and Chocolate Museum. |
| **Demographics**<br>Based on the last 2011 census, Moruga is a small village of 316 people (182 are male and 134 are female) (CSO, 2011). Of these residents, 24 are elderly (65 years and older), 73 are minors (15 years and under) and 220 form the working population. 62 percent of Moruga's population that is 15 years and older is employed, while 2.2 percent are seeking employment (CSO, 2011). Since 2018, with its close proximity to Venezuela, there has been an influx of migrants due to the political and social upheavals in Venezuela.<br>**Socio-economic activities**<br>• In a 2018 livelihoods survey, Moruga livelihood activities were noted as fishing, farming (including fig agriculture) and hunting, with fishing being the main livelihood and income source (FAO, forthcoming).<br>• Moruga, which includes the communities of La Rufin and Grand Chemin, is one of the main fish landing sites in Trinidad. There are approximately 130 fishers in La Rufin operating 65 vessels and 100 fishers at Grand Chemin operating 50 vessels (Mieux, 2019). The main gear type used at La Rufin is fish pot followed by mono filament, with the most common species landed being cro cro, sierra mackerel and shark (gummy). At Grand Chemin, main gear type is á la vive followed by fillet, with the most common species landed being sierra mackerel, whitefish and snapper (Fisheries Division, 2016).<br>• Sale of fish does not involve value-added processes such as cleaning and packaging, flash freezing, drying, smoking or salting. All catch is sold fresh to middlemen who wholesale and retail in other population centres.<br>• Marijuana is planted illegally in the hills, along the boundaries of the proposed PA, for sale and personal use (FAO, forthcoming).<br>**Past assessments** |

A livelihood assessment, socio-economic assessment and knowledge, attitudes and practices (KAP) survey were conducted under the GEF-funded project, Improving Forest and Protected Areas Management in Trinidad and Tobago, from 2017-2020 (FAO, forthcoming). Key hazards and other issues highlighted include coastal erosion, theft and kidnappings at sea given the close proximity to Venezuela, and oil spills due to offshore drilling along the south coast of Trinidad (FAO, forthcoming).

## Methodology

The vulnerability and capacity assessment (VCA) in Moruga was conducted from 2020-2021 by CANARI and a field team of four persons trained as part of the two-day VCA training workshop held in December 2019 in Trinidad[1].

Participatory geographic information systems (P-GIS) and impact and capacity matrix tools were applied in Moruga in a half-day workshop on February 6, 2020. Production of maps based on information gathered in the workshops was supported by a GIS expert who digitised and input maps into GIS. The field team then conducted 79 surveys over four weeks. Surveys targeted fisherfolk, including fishers, fish processors and vendors, and selected households and individuals that are representative of various demographics, livelihood activities and sectors and vulnerable groups identified in the P-GIS and impact and capacity matrix exercises.

The field team included the fisheries officer/data collector from the Fisheries Division, Trinidad operating in the community, fisherfolk leaders from active fisherfolk organizations in Moruga and other civil society representatives. The field team collectively encompassed a mix of competencies, including in climate change, fisheries and socio-economic/community development, to ensure a holistic approach and effective implementation.

Figure 1: Photos of the vulnerability and capacity assessment workshop in Moruga, Trinidad on February 6, 2020. Photo on left shows the President of the La Ruffin Fisherfolk Organization presenting on the Impact and capacity matrix to prioritise identified climate change hazards. Photos on right show participatory GIS mapping by stakeholders.


*Source*: CANARI (2021)

[1] https://canari.org/wp-content/uploads/2018/02/CC4FISH-TT-VCA-Training-Workshop-Report-Jan2020.pdf

## Key climate change impacts and vulnerabilities for Moruga

The specific findings from the applications of the three vulnerabililty and capacity assessment (VCA) tools in Moruga in 2020-2021 are detailed below.

**Participatory mapping and GIS findings**

During the mapping exercise, community stakeholders identified and mapped a range of climate-related hazards and impacts that they had experienced or which will pose a significant risk to the community of Moruga, as well as specific vulnerable areas and groups (see Figure 28). These hazards included:

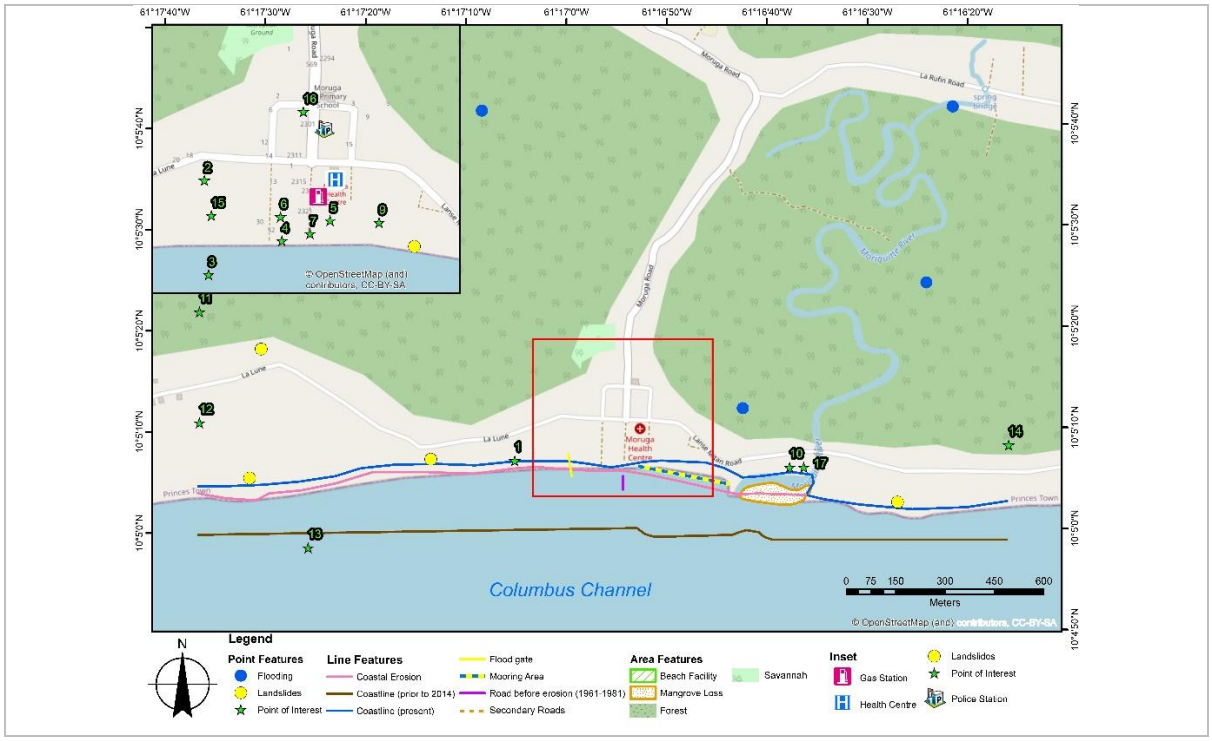
- Coastal erosion and flooding due to higher tides, storm surges and swell events, which especially affects the beach and mangrove ecosystems in Moruga. Coastal erosion impacts physical infrastructure relevant to the fisheries sector (e.g. fishing facility seen in Figure 29), cultural assets (e.g. St. Peter's Monument located on Grand Chemin Beach), and important community establishments such as the Roman Catholic Church and School and local businesses within close proximity to the Grand Chemin Beach. Stakeholders noted that the coastline has receded drastically resulting in loss of beachfront and physical infrastructure such as the Moruga Road.
- Sargassum influxes that impact beaches and fishing grounds and assets (e.g. boat engines, gear and landing site) in Moruga. Fishers noted that sargassum sightings are occurring earlier in the year than previously.
- Inland flooding along rivers impacting communities in the wider Moruga area such as La Ruffin, Basse Terre and Saint Mary's lower areas.
- Landslides identified along coastal cliffs and steeper slopes inland.

Habitat destruction, particularly removal of mangroves, was also noted by stakeholders. Increased coastal erosion has been observed following mangrove removal to establish a beach facility. Rapid erosion now poses a further threat leading to mangrove die-out.

Figure 1: Moruga fishing facility impacted by coastal erosion due to higher tides, storm surges and swell events.


*Source*: CANARI (2021).

Figure 2: Digitised participatory map of Moruga. The map was developed through discussions with community stakeholders on key climate change hazards and related impacts and vulnerabilities.




*Source*: CANARI (2021).

Map created by CANARI (2021); EPSG:4158; OpenStreetMap contributors (2021) Planet dump [9/6/2021]. Retrieved from https://planet.openstreetmap.org. Local knowledge data provided by stakeholders in Moruga, Trinidad during the 'Workshop for the Vulnerability and Capacity Assessment of Moruga' (February 6, 2020).

Points of interest

| # | Description |
|---|---|
| 1 | partial property destruction due to coastal erosion |
| 2 | land earmarked for new fishing facility |
| 3 | sargassum affected area |
| 4 | present fishing facility used for off-loading gear, engines and fish |

| | |
|---|---|
| 5 | Moruga Roman Catholic School and Church |
| 6 | old fishing port |
| 7 | Heritage site (statue of Saint Peter) leaning, affected by high tide and coastal erosion |
| 9 | cemetery |
| 10 | increased erosion due to removed mangrove to build beach facility |
| 11 | landslides affecting Marac area, moving in a westerly direction off the map |
| 12 | La Lune school located in a westerly direction off map, experiencing effects of erosion (wall cracking up) |
| 13 | mangrove extent along coastline circa 1960s; coastline erosion biggest threat to mangrove die-out |
| 14 | Moruga spring bridge, located easterly off map, experiencing effects of river erosion |
| 15 | pump house |
| 16 | Moruga museum |
| 17 | beach facility |

**Impact and capacity matrix findings**

Stakeholders ranked the climate and other related hazards that they had identified and their impacts, including on the fisheries sector and vulnerable areas and groups, during the impact and capacity matrix exercise. Additionally, current or potential coping and adaptation strategies were identified for these impacts.

Coastal erosion, sargassum influxes and increased air temperature/hotter days were the hazards most commonly ranked as highest impact across all categories of resources in Moruga (fisheries, other livelihoods, physical infrastructure and natural resources) (Table 9). Coastal erosion posed the most significant risk, particularly to the fisheries sector, where high impact was noted for fisherfolk and their assets. This includes the old Moruga fishing facility, which has been extensively impacted by coastal erosion and this is compounded by the inadequate upkeep of the facility. Sargassum influxes were also noted as impacting on the coastal and marine ecosystems that support fisheries, including beaches, mangroves and fishing grounds. For non-fisheries livelihoods, flooding inland was also ranked as having a significant impact along with coastal erosion and increased air temperature.

Potential coping and adaptation strategies highlighted include infrastructural and ecosystem-based solutions to address coastal erosion, such as a breakwater or replanting of mangroves. To address sargassum impacts, regular clean-ups with support from the responsible government entity was highlighted, along with the need for research to finding uses for the sargassum. Improved drainage and maintenance of drainage infrastructure was suggested to address flooding impacts on the community. No specific measures were identified for the increased temperature.

Table 1: Impact and capacity matrix for Moruga, Trinidad.

| Key: | 3 – High impact | 2 – Medium impact | 1 – Low impact | 0 – No impact | Blank – N/A |
|---|---|---|---|---|---|

| **Assets** | **Hazards** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | coastal erosion | sargassum | temperature/ hotter days | warmer seas | high tides | landslides | theft/ piracy | flooding | pollution | rainfall | winds |
| **Fisheries assets** | | | | | | | | | | | |
| fishing boats/engine | 3 | 1 | 1 | 1 | 3 | 1 | 3 | | | | |
| fishing gears | 3 | 2 | 1 | 1 | 3 | 1 | 3 | | | | |
| fishing facility | 3 | 2 | 1 | 1 | 3 | 0 | 3 | | | | |
| fishing access | 3 | 2 | 1 | 0 | 3 | 0 | 3 | | | | |
| **Fisheries assets total** | **12** | **7** | **4** | **3** | **12** | **2** | **12** | | | | |
| **Non-fisheries livelihoods** | | | | | | | | | | | |
| agriculture | 1 | 1 | 3 | | | 3 | 3 | 3 | 2 | | |
| government jobs | 3 | 3 | 3 | | | 3 | 3 | 2 | 3 | | |
| business owners | 3 | 3 | 3 | | | 3 | 3 | 3 | 1 | | |
| teaching | 3(near coast) | 1 | 3 | | | 1 | 1 | 3 | 3 | | |
| recreation/sports | 3 | 3 | 1(seasonal) | | | 1 | 1 | 3 | 1 | | |
| unemployment | 1 | 1 | 1 | | | 1 | 3 | 3 | 2 | | |
| taxi drivers | 1 | 1 | 3 | | | 3 | 1 | 3 | 1 | | |
| community groups | 2 | 1 | 3 | | | 1 | 1 | 3 | 3 | | |
| **Livelihoods total** | **17** | **14** | **20** | | | **16** | **16** | **23** | **16** | | |
| **Physical infrastructure** | | | | | | | | | | | |
| schools | 3 | 1 | 0 | 0 | 3 | 2 | | 0 | | | |
| roads | 3 | 0 | 0 | 0 | 3 | 3 | | 0 | | | |
| churches | 3 | 0 | 0 | 0 | 3 | 3 | | 0 | | | |
| beach facility | 3 | 3 | 0 | 0 | 3 | 0 | | 0 | | | |
| residential homes | 3 | 1 | 0 | 0 | 3 | 0 | | 0 | | | |
| historical sites | 3 | 0 | 0 | 0 | 3 | 2 | | 0 | | | |
| **Physical infrastructure total** | **18** | **5** | **0** | **0** | **18** | **10** | | **0** | | | |
| **Natural resources** | | | | | | | | | | | |

| Assets | Hazards | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | coastal erosion | sargassum | temperature/ hotter days | warmer seas | high tides | landslides | theft/ piracy | flooding | pollution | rainfall | winds |
| mud volcano | 0 | 0 | 3 | | | | | 0 | 1 | 2 | 2 |
| tar lake | 0 | 0 | 3 | | | | | 0 | 1 | 2 | 2 |
| stone quarry | 0 | 0 | 1 | | | | | 0 | 1 | 1 | 1 |
| trinity hills | 1 | 0 | 2 | | | | | 0 | 0 | 1 | 1 |
| trinity dam | 0 | 0 | 3 | | | | | 2 | 2 | 2 | 2 |
| beach | 3+ | 3 | 2 | | | | | 0 | 3 | 2 | 2 |
| mangrove | 3+ | 3 | 3 | | | | | 0 | 3 | 0 | 0 |
| river | 3 | 2 | 2 | | | | | 2 | 2 | 0 | 0 |
| fishing grounds | 0 | 3 | 3 | | | | | 0 | 3 | 2 | 2 |
| **Natural resources total** | **10+** | **11** | **22** | | | | | **4** | **16** | **12** | **9** |
| **All categories total** | **57** | **37** | **46** | **3** | **30** | **28** | **28** | **27** | **32** | **12** | **9** |
| **Potential coping or adaptation strategies** | **Coastal erosion**<br>- retaining wall/breakwater<br>- sandbags (for houses)<br>- building slope walls<br>- replant mangroves to buffer impacts<br><br>**Sargassum**<br>- regular clean-ups and beach maintenance by responsible government entity<br>- find uses for sargassum seaweed<br><br>**Flooding**<br>-increase drainage and dredging of rivers<br>- improve and maintain drainage infrastructure (e.g. regular cleaning, ensuring infrastructure is in good condition) | | | | | **Landslides**<br>- planting trees with deep roots to hold the land<br><br>**Theft/piracy**<br>- more coast guard patrols for enforcement and surveillance<br>- proper security<br><br>**Pollution**<br>- promote clean fuels and proper waste disposal<br>- stop use of open ocean for testing grounds (seismic surveys)<br><br>**Winds**<br>- replant trees to serve as wind breaks | | | | | |

*Source*: CANARI (2021).

**Survey findings**

A total of 79 surveys were administered in Moruga as part of the VCA, with 32 percent of respondents being female and 68 percent male. 23 percent of respondents were 20-39 years, 39 percent were aged 40-59 and 15 percent were over 59 years. Survey responses disaggregated by age and gender revealed no significant differences in responses among groups.

Fisheries and agriculture were the main source of income for Moruga respondents. 39 percent of respondents indicated the fisheries sector was their primary source of income, 17 percent work in public sector and 14 percent in agriculture. In terms of secondary sources of income, 33 percent of respondents indicated agriculture, while 25 percent indicated fisheries. Other sources of income included self-employment, pension and the oil and gas sector.

The majority of survey respondents working within the fisheries and agriculture sectors were male and aged 40-59, while those working in the public sector were largely female ranging in age from 20-59.

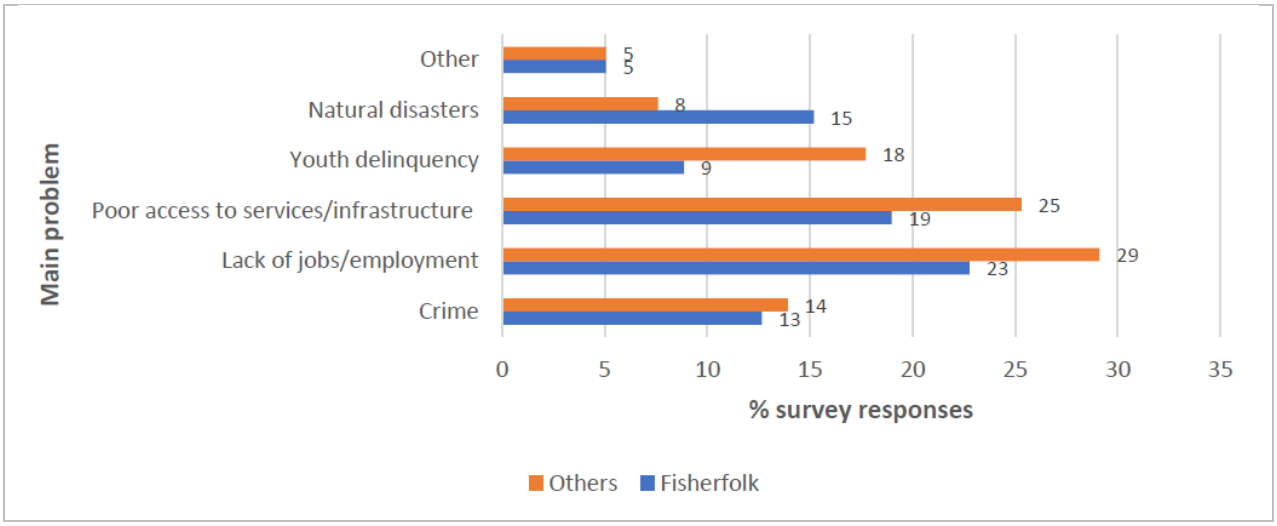
Table 2: Sources of income for Moruga survey respondents.

| Source of income | agriculture | fisheries | public sector | tourism | other | no answer |
|---|---|---|---|---|---|---|
| **Primary source** | 14% | 39% | 17% | 0% | 30% | 2% |
| **Secondary source** | 33% | 25% | 3% | 0% | 39% | 36% |

*Source*: CANARI (2021).

Lack of employment was the main problem identified by respondents (52 percent), followed by poor access to services and infrastructure (44 percent). Crime (27 percent), youth delinquency (27 percent) and natural disasters (23 percent) were also highlighted as issues affecting respondents' households or livelihoods. In particular, fisherfolk highlighted natural disasters as a main problem in higher numbers (15 percent of respondents) than others surveyed (8 percent). All other problems were identified as more significant than natural disasters by those working outside the fisheries sector.

Figure 3: Main problems impacting fisherfolk vs. other Moruga respondents' households and livelihoods.

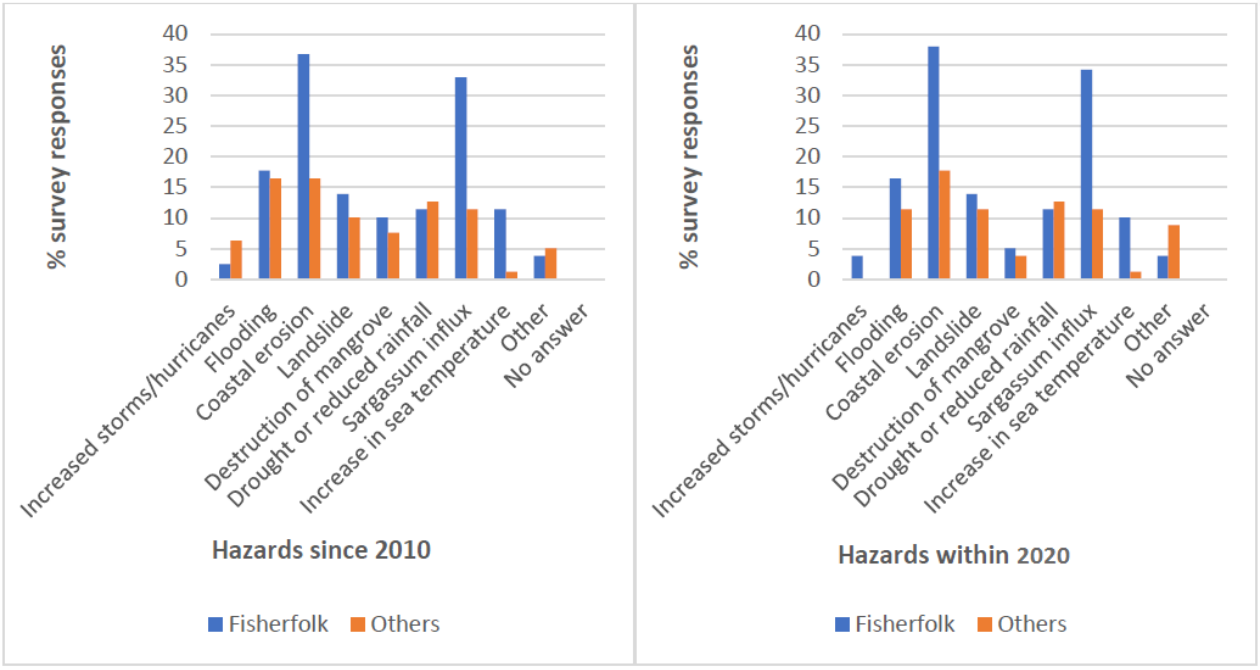



*Source*: CANARI (2021).

Climate and other hazards affecting the Moruga community

Coastal erosion was identified with most frequency by respondents (55 percent), followed by sargassum influx (45 percent), then flooding, landslides and drought (25-30 percent). In particular, fisherfolk identified coastal erosion and sargassum influx as posing key threats to their household or livelihood compared to respondents working in other sectors (Figure 30).

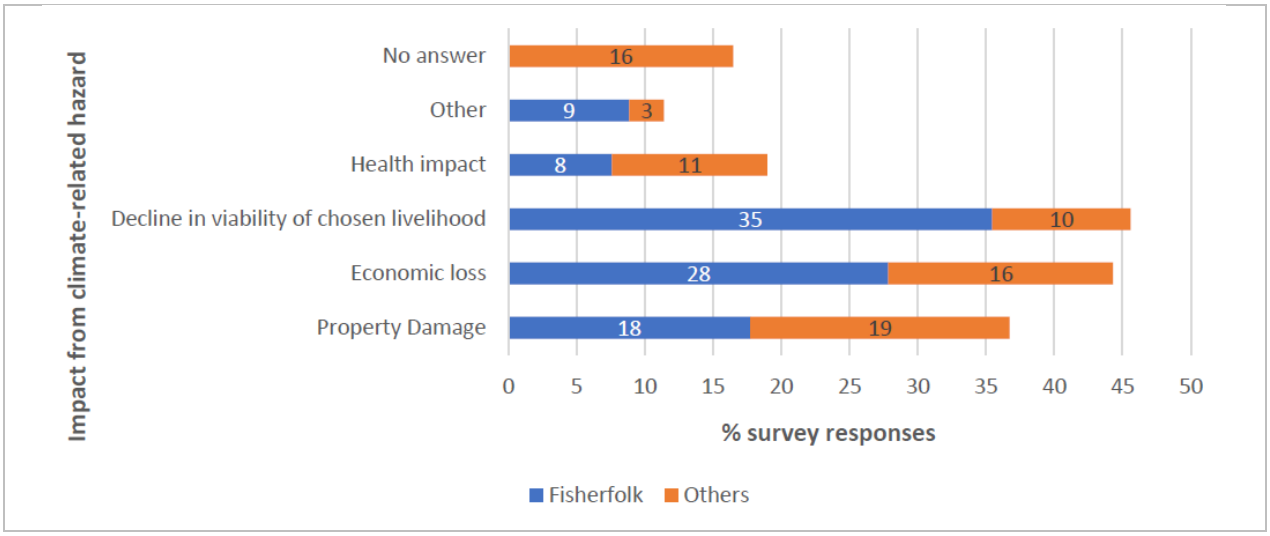
Figure 4: Climate and other hazards affecting households and livelihoods in Moruga.




*Source*: CANARI (2021).

In terms of resulting impacts from these hazards, decline in livelihood viability, economic loss and property damage were indicated at 46 percent, 44 percent and 37 percent respectively by survey respondents, including fisherfolk. Health impacts were also indicated by 19 percent of respondents (Figure 31).

Figure 5: Impacts from climate and other related hazards identified by Moruga stakeholders.

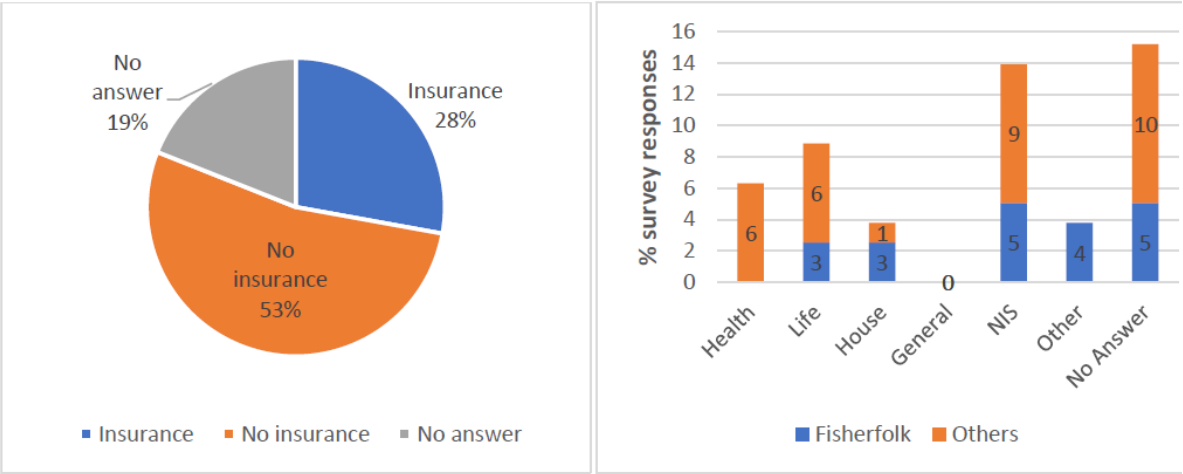



*Source*: CANARI (2021).

Recovery methods and coping and adaptation strategies

Of those surveyed, 22 percent indicated they were recovered from the identified hazards and their impacts in less than 24 months, 30 percent had taken 24+ months to recover and 15 percent were not yet recovered. 53 percent of survey respondents had no insurance to reduce risks and support recovery when needed. Of the 28 percent that had insurance, 14 percent had NIS, 9 percent possess life insurance and 6 percent health insurance. No fisherfolk indicated possession of health insurance and low numbers indicated NIS, life and house insurance (Figure 32).

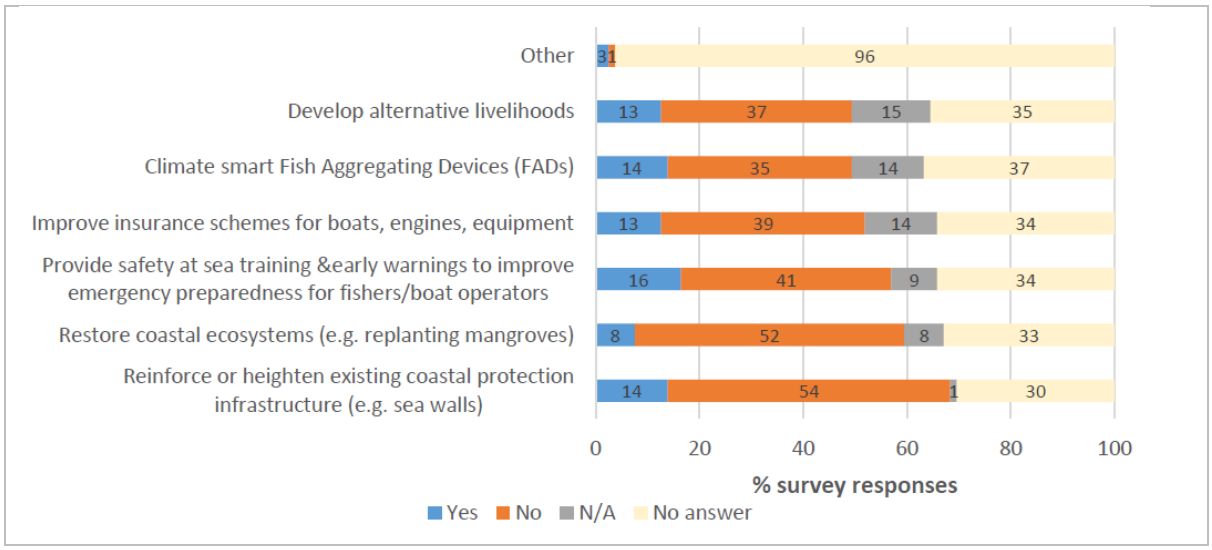
Figure 6: Survey respondents insurance status and type of insurance for Moruga, Trinidad.




*Source*: CANARI (2021).

While a few Moruga respondents noted adaptation measures that have been implemented, generally respondents indicated that no measures had been implemented. In terms of the coastal and marine zone, adaptation measures highlighted were safety at sea training and early warnings to improve emergency preparedness for fishers/boat operators (16 percent), reinforcement of coastal protection infrastructure (14 percent), use of FADs (14 percent) and development of alternative livelihoods (13 percent) (Figure 33).

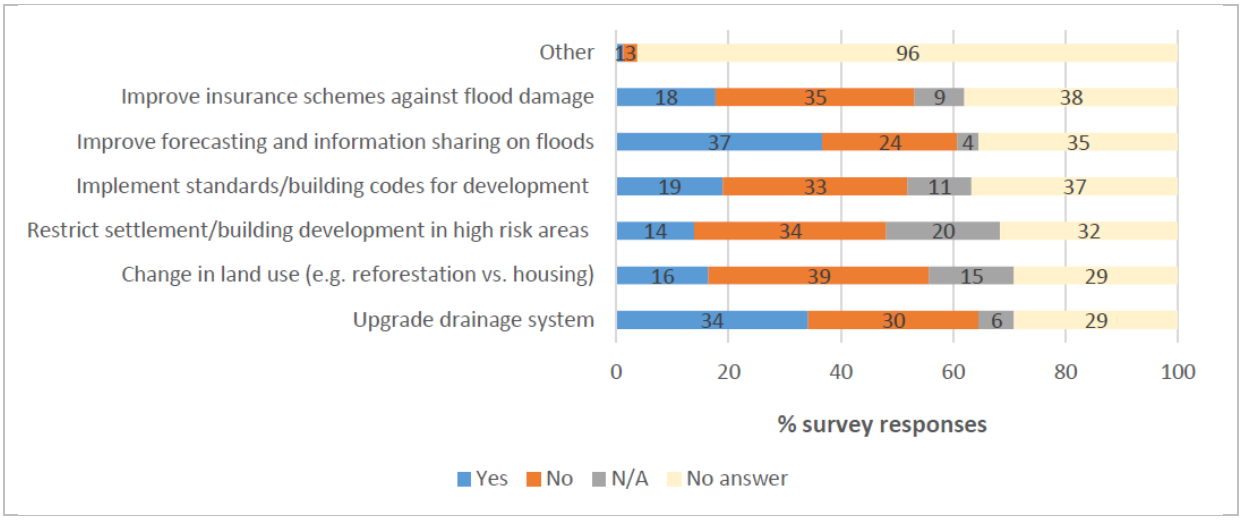
Figure 7: Coastal and marine zone adaptation measures for Moruga, Trinidad.




*Source*: CANARI (2021).

In terms of flood protection, adaptation measures indicated by survey respondents included improving forecasting and information on floods (37 percent), upgrading the drainage system (34 percent), improving building codes for development (19 percent), accessing insurance for flood damage (18 percent) and changing land use via reforestation (16 percent) (Figure 34).

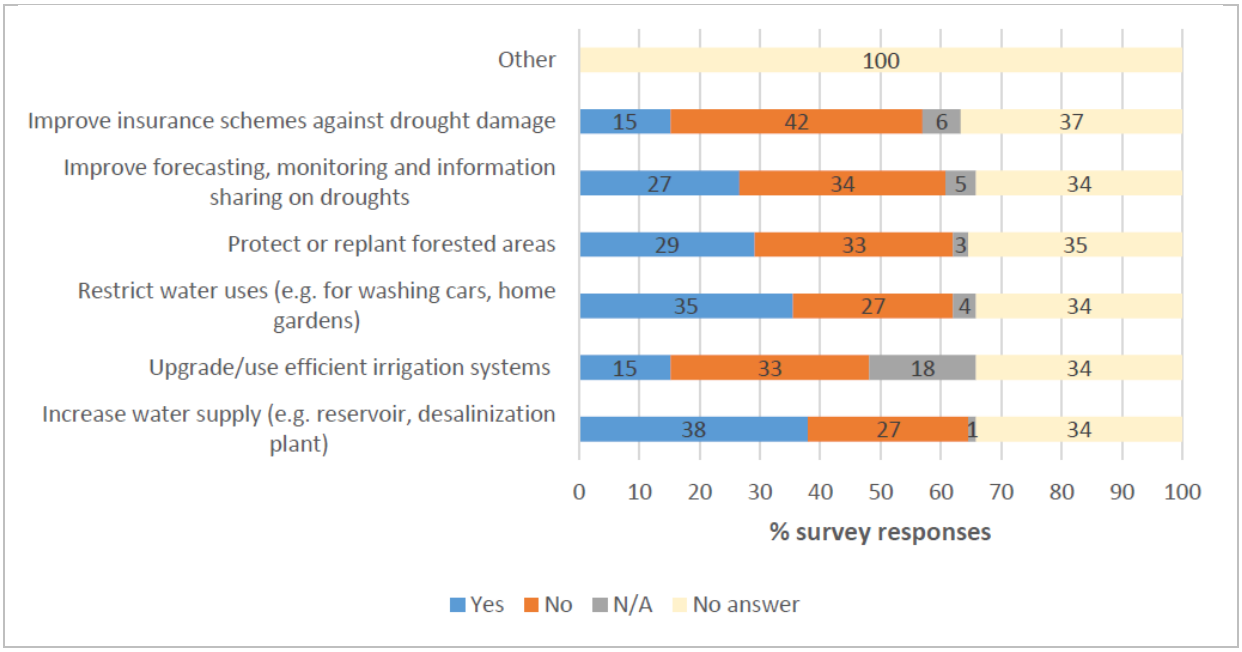
Figure 8: Flood protection adaptation measures for Moruga, Trinidad.




*Source*: CANARI (2021).

For drought, respondents indicated adaptation measures such as increasing water supply (38 percent), establishing water restrictions (35 percent), protecting/replanting of forested areas (29 percent), and improved forecasting and information sharing on droughts (27 percent). These adaptation measures likely reflect the recent response to drought conditions experienced in Trinidad and Tobago and across the Caribbean from 2019 to 2020, where the Water and Sewage Authority in Trinidad and Tobago placed restrictions on water use and improved information sharing on drought or water shortages and water-saving measures.

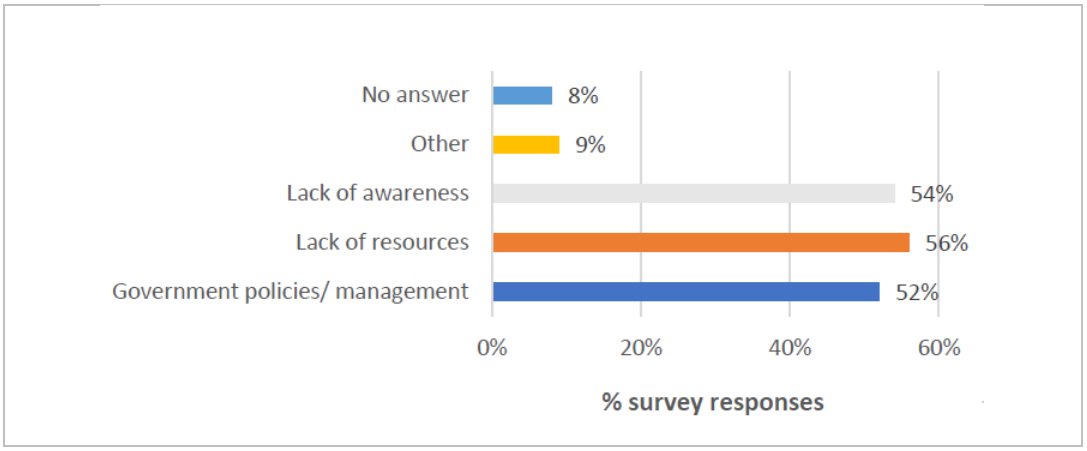
Figure 9: Drought and low flow protection adaptation measures for Moruga, Trinidad.




*Source*: CANARI (2021).

In terms of main barriers to implementation of adaptation measures in Moruga, 56 percent of respondents indicated lack of resources, 54 percent lack of awareness and 52 percent highlighted weak government policies/management (Figure 36).

Figure 10: Main barriers to putting in place measures to address the impacts identified in Moruga.




*Source*: CANARI (2021).

**Summary of findings**

A summary of the key climate change impacts, vulnerabilities and adaptation priorities is outlined in Table 3.

Table 3: Key climate change impacts, vulnerabilities and adaptation priorities identified by Moruga stakeholders using the vulnerability and capacity assessment tools.

| Climate-related hazards | Key impacts | Vulnerable groups and areas | Priorities for adaptation |
|---|---|---|---|
| Coastal and marine biodiversity and ecosystems | | | |
| • SLR/higher tides<br>• Storms and storm surge<br>• Sargassum influx<br>• Flooding along rivers<br>• Landslides | • Coastal erosion impacting beaches and leading to loss of coastal vegetation, including fringing mangroves and other habitat as a result of rising tides, storms and surges and the effects of swell events.<br>• Forested area is being lost along Moruga's cliffs due to coastal erosion and landslides as a result of rising tides, storms and surges and the effects of swell events. | • The coastline of Moruga, including beaches, mangroves and forested areas that extend to the coast, and associated biodiversity.<br>• Recreational users of beaches.<br>• Hunters affected by loss of forested areas and associated wildlife. | • Building breakwater or other infrastructure for coastal protection.<br>• Restoring mangroves for coastal protection.<br>• Replanting trees with deep roots to improve the stability and reduce risk of landslides and cliff erosion.<br>• Improved beach maintenance and clearing of sargassum influxes. |

| Climate-related hazards | Key impacts | Vulnerable groups and areas | Priorities for adaptation |
|---|---|---|---|
| | • Marine ecosystems are impacted by influx of sargassum. | | |
| Livelihoods and socio-economic practices | | | |
| • SLR/higher tides<br>• Storms and storm surge<br>• Sargassum influx<br>• Flooding along rivers<br>• Landslides | • Damage to or loss of fishing boats, gear, and fisheries-related infrastructure (e.g. landing site, fishing facility) due to coastal erosion from storms and surge, swell events, SLR and sargassum influxes.<br>• Disruptions to fishing operations and potential decline in fisherfolk's income due to sargassum influxes, storms and surge and SLR. This is compounded by crime and security risks associated with fishing in close proximity to Venezuela and high number of migrants in the area.<br>• Damage to community infrastructure, businesses and residential homes as a result of coastal erosion due to storms and surge and SLR and inland flooding along rivers. | • Fisherfolk in Moruga and those dependent on the fisheries sector for their livelihoods (e.g. fishers, boat owners, vendors) including their family members dependent on their income.<br>• Households impacted by damage to community infrastructure (e.g. schools, religious institutions, heritage sites) and residential homes due to coastal erosion and inland flooding.<br>• Business owners and employees working in coastal areas. | • Building breakwater or other infrastructure for coastal protection.<br>• Restoring mangroves for coastal protection.<br>• Improved beach maintenance and clearing of sargassum influxes.<br>• Improved flood protection, including improved drainage and use of sandbags, to reduce the impact on community infrastructure. |
| Settlements and infrastructure | | | |
| • SLR/higher tides<br>• Storms and storm surge<br>• Sargassum influx<br>• Flooding along rivers<br>• Landslides | • Property damage and loss of built coastal infrastructure (e.g. schools, businesses, roads) from coastal erosion due to storms and surge, SLR and swell events.<br>• Property damage and loss of infrastructure (e.g. roads) due to | • Fish landing site and related infrastructure.<br>• Community infrastructure (e.g. schools, religious institutions, cultural/heritage monuments) along the coast.<br>• Home or business owners at risk of | • Building breakwater or other infrastructure for coastal protection.<br>• Improved flood protection, including use of sandbags and improved drainage, to reduce the impact on community infrastructure. |

| Climate-related hazards | Key impacts | Vulnerable groups and areas | Priorities for adaptation |
|---|---|---|---|
| | inland flooding along rivers and related landslides.<br>• Damage to and loss of cultural/heritage assets (e.g. St. Peter's statue) as a result of coastal erosion due to storms and surge, SLR and swell events. | losing their coastal properties. | |

*Source*: CANARI (2021).

## Stakeholder Validation

A validation exercise was conducted in Moruga as part of the action planning workshop on June 18, 2024 to determine if there were any significant changes to the key climate change impacts and vulnerabilities identified in the VCA in 2020-2021.

Below is a summary of updates shared by fisherfolk and other community residents:

- Coastal erosion has continued and they've lost a significant part of the wall of the Catholic Primary School and the statue of Saint Peter is falling over. Additionally, residents and visitors cannot access La Retraite beach due to the extent of the erosion.
- The fishing facility cannot be used by the fisherfolk as lost approximately another 20 feet of land and this has undercut the building; a new, much larger facility is about to be completed by the Fisheries Division at a nearby site further down the coast.
- Rising sea level continues to affect the cemetery.
- Sargassum influxes continue to impact Moruga beaches and fisherfolk whose nets and boat engines get damaged. The influxes also appear to be lasting for a longer period. Currently, there is not any regular cleaning of the beaches by the Regional Corporation or other organisations, and there appears to be lack of clarity on which agency has the mandate and responsibility for this. This impacts on livelihoods based on fishing and beach recreation (e.g. sales of drinks, ice cream and other items)
- Infrastructure is not able to withstand rough seas and storm surges.
- Drainage issues persist during heavy rains. In particular, one drain near the new fishing facility has been blocked due to poor construction design and is causing land behind it to flood and become waterlogged.
- There has been an increase in dry spells and forest fires, with deaths, injury, crop and property damage and further water shortages in the Moruga community. E.g. recently a forest fire spread to a house in the community and killed 2 persons with disabilities who could not escape easily. Also, farmers affected by water shortages and forest fires that get out of control and result in loss of their crops.
- An increase in Venezuelan migrants has occurred in Moruga since 2021, raising health, safety and security concerns. In addition, fishers have reported an increase in theft and kidnappings of fishers at sea linked to illegal activities (e.g. human and drug trafficking between Venezuela and Trinidad and Tobago). The need was highlighted for further patrols

by the police, Customs and Coast Guard to deter migrants and illegal activities related to drug and human trafficking.
- COVID-19 risks, and strict regulations on opening hours and local travel, led to lengthy closures of businesses and fisherfolk not being able to fish as regularly during the pandemic. Residents found creative ways to earn an income via “shop houses” where sold food and other items from their house while their businesses closed.

Based on the above, they also recommended additional actions to adapt and build resilience:

- Establishment of other emergency shelters as the designated shelter at the Moruga Secondary School is not always accessible when it floods
- Rethinking design of new drainage near fishing facility to ensure not blocking existing drains and exacerbating flooding

# Appendix 4. Moruga Community Resilience Plan

Bold = priority impacts and actions; ** = top priorities

| Community impacts and risks | Vulnerable areas and groups | Actions to adapt/build resilience | Roles and responsibilities (Lead/supporting actors) | Required resources | Time frame | Indicators of Success |
|---|---|---|---|---|---|---|
| **Coastal ecosystems and infrastructure** | | | | | | |
| **<u>Sargassum influxes</u>**<br><br>**Impacts:**<br>- **Major influxes on beach are unsightly and rotting sargassum has strong odour (hydrogen sulphide gas)**<br>- **Damage to electronic equipment and machinery (e.g. corrosion of copper) from hydrogen sulphide gas**<br>- **Risk of spreading new invasive species in sargassum mats** | **Vulnerable areas:**<br>- **Grand Chemin**<br>- **La Retraite**<br>- **La Lune**<br>- **Morne Diablo**<br><br>**Vulnerable groups:**<br>- **Fisherfolk**<br>- **Beachgoers**<br>- **Elderly, infants and others who suffer from respiratory diseases**<br>- **Households living near coast**<br>- **Property owners along coast**<br>- **Vendors and tourism-related small businesses** | - ****Regular beach clean ups to avoid pile-up of large amounts of sargassum**<br>- **Preventative measures to reduce damage to electronic equipment and machinery for residential and commercial purposes**<br>- **Improved monitoring to inform response** | - **National Sargassum Taskforce (lead)**<br>- **Princes Town Regional Corporation**<br>- **Institute of Marine Affairs (IMA) and Environmental Management Authority (EMA) / Ministry of Planning, Economic Affairs and Development**<br>- **Ministry of Agriculture, Lands and Fisheries**<br>- **Village councils – Basseterre, La Lune and others**<br>- **Fisherfolk**<br>- **Basseterre Women's Group, Moruga Youth Development Organisation (MYDO) and other local community groups**<br>- **Local businesses** | - **Technical expertise (marine science inc. sargassum, ecosystem restoration, climate adaptation)**<br>- **Financing**<br>- **Equipment**<br>- **Labour (can be provided by local community groups for clean-ups and monitoring)** | **Short to medium term (1-6 years)** | - **Reduced length of time that sargassum stranded on beach**<br>- **Reduced costs to households and businesses along coast for loss and damage of equipment and machinery**<br>- **Monitoring system established to detect new invasive species and alert relevant authorities** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | - CANARI and other NGOs<br>- University of West Indies (UWI) | | | |
| **Coastal erosion** due to sea level rise, storms and storm surge<br><br>Impacts:<br>- Beach erosion<br>- Reduced/loss of access to beaches and coastal resources for residents and visitors, impacting well-being and livelihoods<br>- Damage and loss of coastal property, infrastructure and monuments/ heritage sites | Vulnerable areas:<br>- Grand Chemin (old fishing facility in disrepair; wall of Roman Catholic Primary School undermined; statue of Saint Peter falling)<br>- La Retraite (beach inaccessible to visitors and local vendors)<br>- La Lune (fish landing site not in use due to erosion)<br>- Morne Diablo (fish landing site not in use; replaced with desalination plant)<br>- Marac, Batiment and | - **Breakwater (e.g. groynes), which is strategically placed to allow boat access, to protect high risk areas<br>- **Restoration of mangroves and coastal vegetation along beaches<br>- Improved monitoring to inform response<br>- Emergency shelters upgraded and increased to cater for displaced<br>- Building codes upgraded to reflect sea level rise and more extreme weather and enforced<br>- Improved access to insurance for property owners and for fisherfolk (including boats, engines and gear) | - Coastal Protection Unit (CPU)/ Ministry of Works and Infrastructure (co-lead)<br>- IMA, EMA and Town & Country Planning Division, Ministry of Planning, Economic Affairs and Development (co-lead)<br>- Village councils – Basseterre, La Lune and others (co-lead)<br>- Princes Town Regional Corporation<br>- Office of Disaster Preparedness and Management (ODPM)<br>- Fisheries Division /Ministry of Agriculture, Lands and Fisheries<br>- National Trust of Trinidad and Tobago<br>- Moruga/La Ruffin Fishing Association, Grand Chemin Fishing Association | - Technical expertise (coastal engineering, construction) ecosystem restoration, climate adaptation)<br>- Financing (significant costs to build and maintain breakwater)<br>- Equipment<br>- Materials<br>- Seedlings for restoration<br>- Labour | Medium term (4-6 years) | - Extent of beach area remains same/ increased<br>- Improved health and extent of vegetation<br>- Reduced costs for damage, and repair or maintenance, of buildings and other coastal infrastructure |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Quasime also at risk**<br><br>**Vulnerable groups:**<br>- **Fisherfolk**<br>- **Beachgoers**<br>- **Households living near coast**<br>- **Property owners along coast**<br>- **Vendors and tourism-related small businesses** | | - **MYDO and other local community groups**<br>- **Property owners**<br>- **Insurance providers**<br>- **SpeSEAS, CANARI and other NGOs**<br>- **T&T Red Cross Society (TTRCS)**<br>- **UWI** | | | |
| <u>Ecosystem degradation</u> from sea level rise, storms and rising sea surface temperatures<br><br>Impacts:<br>- Degradation and loss of mangroves and other coastal vegetation<br>- Degradation and loss of coral reefs (already compromised by pollution and coastal development) | | - Restoration and protection of mangroves, reefs, and eroding cliffs (e.g. using vetiver grass)<br>- Implementation of artificial reefs<br>- Underwater clean ups to remove old nets and other marine litter affecting reefs and marine life | - IMA (co-lead)<br>- Fisherfolk and dive/tour operators (co-lead)<br>- EMA/ Ministry of Planning, Economic Affairs and Development<br>- Forestry Division/ Ministry of Agriculture, Lands and Fisheries<br>- Princes Town Regional Corporation<br>- Village councils – Basseterre, La Lune and others<br>- Local community groups<br>- IAMovement, SpeSEAS, CANARI and other NGOs<br>- UWI | - Technical expertise (marine science, ecosystem restoration, climate adaptation, SCUBA diving)<br>- Financing<br>- Equipment/ SCUBA gear<br>- Materials<br>- Seedlings and coral for restoration<br>- Labour (can be provided by local community groups for clean ups and restoration) | Short to medium term (1-6 years) | - Improved health and extent of mangroves and other coastal vegetation<br>- Extent of cliffs remains same/ increased<br>- Coral cover and health increased |
| <u>Displacement</u> due to sea level rise and coastal erosion | | - Managed retreat from low-lying and other at-risk areas | - CPU/ Ministry of Works and Infrastructure (lead) | - Technical expertise (coastal | Long-term (over 6+ years) | - Reduced costs for loss and damage of |

| | | | | | | |
|---|---|---|---|---|---|---|
| Impacts:<br>- Possible out-migration of residents to other communities/ countries if major loss of coastline and decline in key livelihoods into future<br>- Shift to illegal activities with decline in fishing and other key livelihoods | | to reduce future loss of property/ infrastructure and related livelihoods<br>- Transboundary fishing agreements established for CARICOM region to allow fisherfolk to fish in other countries where sustainable | - IMA, EMA and Town & Country Planning Division / Ministry of Planning, Economic Affairs and Development<br>- Fisheries Division /Ministry of Agriculture, Lands and Fisheries<br>- Princes Town Regional Corporation<br>- Village councils – Basseterre, La Lune and others<br>- Moruga/La Ruffin Fishing Association, Grand Chemin Fishing Association and local community groups<br>- UWI | engineering, construction, climate adaptation, international relations)<br>- Financing (significant costs for managed retreat)<br>- Equipment<br>- Materials<br>- Labour | | property and infrastructure<br>- Number of transboundary fishing agreements |
| **Fisheries** | | | | | | |
| **<u>Shift in ocean conditions and temperatures</u>**<br><br>**Impacts:**<br>- **Decrease in abundance of certain fish species in ocean (e.g. sardines in nearshore areas, linked to loss of feed) and in** | **Vulnerable groups include:**<br>- **Fisherfolk**<br>- **Households dependent on fishing as key source of income or food**<br>- **Recreational fishers**<br>- **Tour operators** | - ****Construction of flood lights at new fishing facility and other strategic locations to attract feed (e.g. algae) and increase fish abundance in nearshore areas**<br>- ****Awareness raising among fisherfolk on sustainable fishing** | - **Fisheries Division/ Ministry of Agriculture, Lands and Fisheries (co-lead)**<br>- **Moruga/La Ruffin Fishing Association and Grand Chemin Fishing Association (co-lead)**<br>- **National Agricultural Marketing and Development** | - **Technical expertise (marine science, sustainable fisheries)**<br>- **Financing**<br>- **Equipment**<br>- **Materials**<br>- **Labour** | **Short to medium term (1-6 years)** | - **Increased catch and size of fish in nearshore areas and Moruga river mouth**<br>- **Increased variety of fish species caught (including nearshore and pelagic species)** |

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| **mouth of Moruga river (e.g. catfish and crab)**<br>**- Increase in distance travelled to catch fish and fuel costs due to shifting fish distribution and migration** | **(fishing charters)** | **practices (e.g. harvest rates, vessel speed and anchoring)**<br>**- Adoption of fish aggregating devices (FADs) with proper use and management**<br>**- Shifting to other fishing areas and types of fish species**<br>**- Fuel subsidy/ compensation to fisherfolk to offset high fuel costs**<br>**- **Diversification of livelihoods for fisherfolk (e.g. fish and fish waste processing to produce value-added products, apiculture, aquaculture, mariculture), including training and provision of equipment/ materials** | **Corporation (NAMDEVCO)**<br>**- Fisherfolk**<br>**- Basseterre Women's Group**<br>**- MYDO**<br>**- CANARI**<br>**- Caribbean Fisheries Training and Development Institute (CFTDI)**<br>**- UWI**<br>**- UN Food and Agriculture Organization (FAO)**<br>**- Caribbean Agricultural Research & Development Institute (CARDI)**<br>**- Inter-American Institute for Cooperation on Agriculture (IICA)** | | | **- Increased number of fisherfolk engaged in alternative livelihoods** |

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| <u>Sargassum influxes</u><br><br>Impacts:<br>- Damage to boats, engines and nets/other fishing gear<br>- Blocked access to fish landing sites<br>- Decrease in fishing days and related income | Vulnerable areas:<br>- Grand Chemin fishing facility and other landing sites<br><br>Vulnerable groups:<br>- Fisherfolk<br>- Households dependent on fishing as key source of income or food<br>- Recreational fishers<br>- Tour operators (fishing charters) | - Adoption of preventative measures to reduce damage to boat engines (e.g. cages for propellors to keep out sargassum) and gear<br>- Targeted assistance/ compensation to fisherfolk for income lost due to sargassum clogging landing sites and damage to boats, engines and gear<br>- Access to insurance for fishing boats, engines and gear and personal insurance for fisherfolk<br>- Diversification of livelihoods (e.g. apiculture, aquaculture, and collection and use of sargassum to create value-added/ commercial products like liquid fertiliser) | - Fisheries Division/ Ministry of Agriculture, Lands and Fisheries (co-lead)<br>- Moruga/La Ruffin Fishing Association and Grand Chemin Fishing Association (co-lead)<br>- National Sargassum Taskforce<br>- Fisherfolk<br>- Basseterre Women's Group<br>- MYDO<br>- Local businesses/ entrepreneurs<br>- Finance and Insurance providers<br>- CFTDI<br>- UWI<br>- FAO<br>- CARDI<br>- IICA | - Technical expertise (marine science, sustainable fisheries, climate adaptation)<br>- Financing (significant costs for research and commercial-isation of sargassum-based products)<br>- Equipment<br>- Materials<br>- Labour | Short to medium term (1-6 years) | - Reduced costs to fishers for loss and damage of boats, engines, nets/other fishing gear<br>- Increased number of fisherfolk engaged in alternative livelihoods<br>- Increased number of value-added/ commercial products developed locally from sargassum |

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| | | - Investment in research and development on sargassum uses and products | | | | |
| Extreme weather due to heavy rainfall, storms and storm surge, and rough seas<br><br>Impacts:<br>- Damage to boats, engines and nets/other fishing gear<br>- Damage to Grand Chemin fishing facility and other landing sites due to flash flooding<br>- Safety issues at sea for fisherfolk with stronger winds and rougher seas (compounded by theft and security concerns linked to illegal activities between Venezuela and | Vulnerable groups include:<br>- Fisherfolk<br>- Households dependent on fishing as key source of income or food<br>- Recreational fishers<br>- Tour operators (fishing charters)<br>- Maritime related businesses | - Safety at sea training and access to required equipment (e.g. GPS, VHF radio)<br>- Improved use of early warning systems for extreme weather for fisherfolk (e.g. SMS alerts)<br>- Targeted assistance/ compensation to fisherfolk for income lost and equipment damage due to extreme weather<br>- Access to insurance for fishing boats, engines and gear and personal insurance for fisherfolk<br>- Diversification of livelihoods for | - Fisheries Division/ Ministry of Agriculture, Lands and Fisheries (co-lead)<br>- Moruga/La Ruffin Fishing Association and Grand Chemin Fishing Association (co-lead)<br>- Fisherfolk<br>- ODPM<br>- T&T Coast Guard<br>- T&T Meteorological Service (TTMS)<br>- Basseterre Women's Group<br>- MYDO<br>- Finance and Insurance providers<br>- Telecommunication service providers<br>- CFTDI<br>- UWI<br>- FAO<br>- CARDI<br>- IICA | - Technical expertise (marine science, sustainable fisheries, climate adaptation)<br>- Financing<br>- Equipment<br>- Materials<br>- Labour | Short to medium term (1-6 years) | - Reduced number of safety incidents reported by fisherfolk<br>- Reduced costs to fisherfolk for loss and damage of boats, engines, nets/other fishing gear<br>- Increased number of fisherfolk engaged in alternative livelihoods |

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| Trinidad and Tobago)<br>- Decrease in fishing days and related income due to weather conditions and equipment damage | | fisherfolk (e.g. fish and fish waste processing to produce value-added products, apiculture, aquaculture, mariculture), including training and provision of equipment/ materials<br>- Increase in patrols by Coastal Guard for emergency response and addressing crime and thefts at sea | | | | |
| <u>Hot, dry spells</u> with rising air temperatures<br><br>Impacts:<br>- Increase in rate of spoilage of fish catch with rising air temperatures<br>- Water shortages and issues accessing potable water for ice and cleaning and processing fish | Vulnerable groups include:<br>- Fisherfolk<br>- Households dependent on fishing as key source of income or food | - Improved access to ice and refrigeration for fisherfolk<br>- Increased use of water storage tanks and rainwater harvesting systems at fishing facilities<br>- Awareness raising among fisherfolk of health impacts from climate change and heat stress and possible need to shift | - Fisheries Division/ Ministry of Agriculture, Lands and Fisheries (co-lead)<br>- Moruga/La Ruffin Fishing Association and Grand Chemin Fishing Association (co-lead)<br>- Fisherfolk<br>- NAMDEVCO<br>- Water and Sewerage Authority (WASA)<br>- Ministry of Health<br>- ODPM<br>- TTMS<br>- FAO | - Technical expertise (marine and fisheries science, disaster response)<br>- Financing<br>- Equipment<br>- Materials<br>- Labour | Short term (1-3 years) | - Reduce number of incidents of spoilage of fish catch reported by fisherfolk<br>- Increased access to ice and water for fisherfolk at Grand Chemin and other fishing facilities |

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| - Heat and water stress among fishers at sea | | fishing to cooler times of day | | | | |
| **Tourism** | | | | | | |
| **<u>Hot, dry spells</u> with rising air temperatures**<br><br>**Impacts:**<br>- **Heat stress**<br>- **Water shortages and issues accessing potable water**<br>- **Increase in energy costs with greater use of air conditioning in guesthouses and tourism-related businesses due to heat**<br>- **Increase in need and costs for installing and maintaining water tanks and water-efficient appliances due to water shortages** | **Vulnerable groups:**<br>- **Elderly persons and young children sensitive to heat and water stress**<br>- **Visitors**<br>- **Guesthouse owners**<br>- **Tour operators**<br>- **Vendors along beaches and roadsides**<br>- **Other tourism-related businesses** | - **Use of renewable energy (e.g. solar PV) to power tourism-related businesses, and for water pumps, to reduce energy costs**<br>- **Subsidies to address increased need for air conditioning and energy costs**<br>- **Increased use of water storage tanks, rainwater harvesting and water-efficient systems in tourism-related businesses** | - **T&T Electricity Commission (T&TEC) and WASA/ Ministry of Public Utilities (co-lead)**<br>- **Ministry of Trade, Investment and Tourism (co-lead)**<br>- **Guesthouse and tour operators and other tourism-related businesses (co-lead)**<br>- **Ministry of Energy and Energy Industries**<br>- **Princes Town Regional Corporation**<br>- **Village councils – Basseterre, La Lune and others**<br>- **Global Water Partnership – Caribbean (GWP-C)** | - **Technical expertise (renewable energy, engineering, water resources management)**<br>- **Financing**<br>- **Equipment**<br>- **Materials**<br>- **Labour** | **Short to medium term (1-6 years)** | - **Reduced costs for use of air conditioning or cooling systems among tourism-related businesses**<br>- **Increased use of water storage tanks and rainwater harvesting among tourism-related businesses** |
| <u>Extreme rainfall</u> and high winds, leading to floods and landslides<br><br>Impacts: | Vulnerable groups:<br>- Guesthouse owners in at-risk areas | - Upgrade and maintenance of roads, bridges (inc. raised bridges) and drainage systems | - Ministry of Works and Infrastructure (co-lead) | - Technical expertise (engineering, construction, | Medium term (4-6 years) | - Reduced costs for repair or maintenance of roads, bridges and other |

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| - Decline in visitors and income from tourism due blocked roads and limited access<br>- Damage to guesthouses and tourism-related attractions and infrastructure | - Vendors at beaches and nearby areas<br>- Other tourism-related businesses | to address flooding<br>- Improved access to insurance for tourism-related businesses | - Ministry of Trade, Investment and Tourism (co-lead)<br>- Guesthouse and tour operators and other tourism-related businesses (co-lead)<br>- Princes Town Regional Corporation<br>- ODPM<br>- National Trust of Trinidad and Tobago<br>- Villag councils – Basseterre, La Lune and others<br>- Insurance providers | climate adaptation)<br>- Financing (significant costs for infrastructure upgrade and maintenance)<br>- Equipment<br>- Materials<br>- Labour | | coastal infrastructure<br>- Reduced costs for loss and damage to local tourism-related businesses |
| **Agriculture and forestry** | | | | | | |
| <u>Extreme and variable rainfall</u><br><br>Impacts:<br>- Damage and loss of crops and livestock with storms, floods and droughts<br>- Changes in crop seasons and productivity with changing rainfall patterns<br>- Increase in flash flooding and landslides with | Vulnerable groups:<br>- Small-scale farmers<br>- Rural women producers and other agriculture-related businesses<br>- Property owners in at-risk areas<br>- Young children, elderly and persons with disabilities, | - Adoption of climate-smart agricultural practices (e.g. greenhouses, agroforestry, composting with fish waste etc.) to reduce loss and damage, soil erosion and improve productivity<br>- Improved drainage and hillside rehabilitation to | - Agricultural Planning Division (co-lead) and Forestry Division, Ministry of Agriculture, Lands and Fisheries<br>- Moruga Farmers Association (co-lead)<br>- Farmers<br>- Agriculture-related businesses<br>- Ministry of Works and Infrastructure<br>- EMA and Town and Country Planning Division, Ministry of Planning, Economic | - Technical expertise (climate-smart agriculture, engineering, construction, land rehabilitation, disaster response)<br>- Financing<br>- Equipment<br>- Materials<br>- Labour | Short to medium term (1-6 years) | - Reduced costs for loss and damage of crops and livestock for farmers<br>- Increased number of farmers engaged in alternative livelihoods |

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| heavy rains, resulting in soil erosion and damage to farms and related property/ infrastructure | who are not very mobile<br>- Households dependent on agriculture as key source of income | address flooding and landslides<br>- Improved access to insurance for farmers and rural producers<br>- Diversification of livelihoods for farmers and rural producers (e.g. aquaculture, mariculture), including training and provision of equipment/ materials | Affairs and Development<br>- Princes Town Regional Corporation<br>- ODPM<br>- Village councils – Basseterre, La Lune and others<br>- Basseterre Women's Group<br>- MYDO<br>- Network of Rural Women Producers of Trinidad and Tobago (NRWPTT)<br>- Property owners<br>- Insurance providers<br>- UWI<br>- FAO<br>- CARDI<br>- IICA | | | |
| <u>Hot, dry spells</u> with rising air temperatures<br><br>Impacts:<br>- Heat stress in crops and livestock<br>- Water shortages<br>- Changes in crop and livestock productivity<br>- Increase in forest fires and related | Vulnerable groups:<br>- Small-scale farmers<br>- Rural women producers and other agriculture-related businesses<br>- Households dependent on agriculture as key source of income | - Adoption of climate-smart agricultural practices (e.g. greenhouses, drought-resistant species, water efficient systems etc.) to address heat stress and drought and improve productivity | - Agricultural Planning Division (co-lead) and Forestry Division, Ministry of Agriculture, Lands and Fisheries<br>- Moruga Farmers Association (co-lead)<br>- Farmers<br>- Agriculture-related businesses<br>- WASA<br>- Princes Town Regional Corporation | - Technical expertise (climate-smart agriculture, fire management,disaster response)<br>- Financing<br>- Equipment<br>- Materials<br>- Labour | Short to medium term (1-6 years) | - Reduced incidence of heat stress-related impacts<br>- Reduced costs for loss and damage from drought and forest fires to farmers and related businesses<br>- Increased number of |

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| threats to lives, property/ infrastructure and farmlands | - Young children, elderly and persons with disabilities, who are not very mobile<br>- Property owners in fire-prone and water-scarce areas | - Diversification of livelihoods (e.g. aquaculture, mariculture), including training and provision of equipment/ materials<br>- Improved forest fire management<br>- Improved access to insurance for farmers and related businesses | - ODPM<br>- T&T Fire Services<br>- Village councils - Basseterre, La Lune and others<br>- MYDO<br>- NRWPTT<br>- Property owners<br>- Insurance providers<br>- UWI<br>- FAO<br>- CARDI<br>- IICA | | | farmers engaged in alternative livelihoods |
| **Water and health** | | | | | | |
| **<u>Extreme and variable rainfall</u> leading to floods and dry spells/droughts**<br><br>**Impacts:**<br>- **Decline in availability and quality of potable water (already limited access to pipe-borne water) for households, schools and essential services (e.g. healthcare)**<br>- **Hygiene and sanitation issues** | **Vulnerable groups:**<br>- **Young children, elderly and persons with co-morbidities**<br>- **Households without pipe-borne water**<br>- **Local service providers and businesses without pipe-borne water** | - **Solar-powered desalination plant installed to improve water access**<br>- ****Increased use of rainwater harvesting and water-efficient systems for households, schools and essential services**<br>- ****Emergency shelters upgraded and increased to cater for displaced** | - **Water and Sewage Authority (WASA)/ Ministry of Public Utilities (co-lead)**<br>- **Princes Town Regional Corporation (co-lead)**<br>- **Village councils – Basseterre, La Lune and others (co-lead)**<br>- **EMA and Town and Country Planning Division/ Ministry of Planning, Economic Affairs and Development**<br>- **Ministry of Education**<br>- **Ministry of Health**<br>- **ODPM** | - **Technical expertise (water resources management, renewable energy, engineering)**<br>- **Financing (significant costs to build and maintain plant)**<br>- **Equipment**<br>- **Materials**<br>- **Labour** | **Medium term (4-6 years)** | **Improved, regular supply of potable water to Moruga community** |

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| **due to limited access to potable water** | | | - **Property owners**<br>- **School principals**<br>- **Local service providers**<br>- **GWP-C**<br>- **Habitat for Humanity Trinidad and Tobago**<br>- **TTRCS** | | | |
| <u>Rising air temperatures</u><br><br>Impacts:<br>- Heat stress in humans<br>- Increase in spread of mosquito-borne diseases (e.g. Dengue, Zika, ChikV) | Vulnerable groups:<br>- Children, pregnant women, elderly and persons with disabilities, sensitive to heat stress<br>- Households without air conditioning/ good ventilation<br>- Guesthouses without air conditioning/ good ventilation<br>- Farmers<br>- Fisherfolk<br>- Construction workers and others that work outdoors | - Education and awareness on climate change and health impacts, particularly from heat stress and mosquito-borne diseases<br>- Improved community/ district health services<br>- Increased use of energy efficient/ renewable energy-powered air conditioning<br>- Use of environmentally-friendly mosquito control | - Princes Town Regional Corporation (co-lead)<br>- Village councils – Basseterre, La Lune and others (co-lead)<br>- Ministry of Health/ Regional Health Authority<br>- Ministry of Education<br>Ministry of Public Utilities<br>- School principals<br>- Elderly care providers<br>- Farmers<br>- Fisherfolk<br>- Construction companies<br>- UWI<br>- Caribbean Regional Public Health Agency (CARPHA)<br>- Pan-American Health Organisation (PAHO) | - Technical expertise (public health, engineering, climate adaptation)<br>- Financing<br>- Equipment<br>- Materials<br>- Labour | Short to medium term (1-6 years) | - Reduced incidence of heat stress-related impacts<br>- Reduced incidence of mosquito-borne diseases |