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FINAL TECHNICAL REPORT

Conduct of Fishery-related Ecological and Socio-economic Assessments of the Impacts of Climate Change and Variability and Development of an Associated Monitoring System

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FINAL TECHNICAL REPORT: CONDUCT OF FISHERY-RELATED ECOLOGICAL AND SOCIO-ECONOMIC ASSESSMENTS OF THE IMPACTS OF CLIMATE CHANGE AND VARIBAILITY AND DEVELOPMENT OF AN ASSOCIATED MONITORING SYSTEM

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The Fishery-Related Ecological and Socio-Economic Assessments of the Impacts of Climate Change and Variability consultancy has been conducted with support from the Regional Track of the Pilot Programme for Climate Resilience (PPCR) in the Caribbean, which is executed by the University of the West Indies, Mona (UWI), through its Mona Office of Research and Innovation (MORI); and co-implemented by the Caribbean Regional Fisheries Mechanism (CRFM) with resources provided by the Climate Investment Fund (CIF) through the Inter-American Development Bank (IDB)".

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FOREWORD

This document is the final deliverable under the project titled *"Conduct of Fishery-Related Ecological and Socio-Economic Assessments of the Impacts of Climate Change and Variability and Development of an Associated Monitoring System*" (the Project). With funding from the Inter-American Development Bank's Caribbean Regional Track of the Pilot Programme for Climate Resilience (PPCR), the Project was executed by the Mona Office for Research and Innovation (MORI) at the University of West Indies at Mona, Jamaica, with the Caribbean Regional Fisheries Mechanism (CRFM) as the co-implementer. The project aimed to improve availability and use of information for "climate-smart" planning and management in the fisheries and aquaculture sector in the Caribbean. Although the project yielded data, knowledge products and insights applicable to the entire region, project research and stakeholder engagement activities centered on the six countries with national PPCR programs: The Commonwealth of Dominica, Grenada, Haiti, Jamaica, Saint Lucia, and Saint Vincent and the Grenadines (SVG). Despite a growing understanding of potential impacts of climate change, progress towards fisheries-sector adaptation in the Caribbean region to date has been constrained by a lack of region-specific data and practical guidance. This project built a foundation of data, monitoring frameworks, adaptation strategies, policy recommendations, and communication tools to support a regional climate change response.

Completed between January 2018 and April 2020, the Project consisted of four inter-related Work Packages:

- Work Package 1 (WP1) comprised the focal point of the project and comprised detailed assessments of both the ecological and socio-economic impacts of climate change on the Caribbean fisheries sector. Project outputs included quantitative and spatially-explicit estimates of projected impacts to the distribution and abundance of over 100 key fisheries species; national-level estimates of the economic consequences of changes in species availability on the communities, and economies that depend on them; and value chain analysis stemming from primary research at two local fishing sites (Montego Bay, Jamaica; Kingstown, Saint Vincent and the Grenadines).

- WP2 combined the results of assessment activities and an understanding of needs and capacities in national fisheries departments to develop a monitoring framework and adaptation planning guidance to help systematically track and respond to realized impacts of climate change. To support data and information sharing across the region and strengthen capacity to use the tools developed, this work package also included the development of a data portal and a five-day hands-on training workshop for fisheries officers in the region.

- WP3 was dedicated to improving awareness of and engagement with the science outputs generated in previous phases of the project. A baseline study of knowledge-attitude-and-practice related to climate change and fisheries informed the design and implementation of a communications and stakeholder engagement campaign, which included the dissemination of a poster series and a short documentary film aimed at fisherfolk, as well as an educational slide deck on project outputs aimed at managers and decision-makers.

- WP4 consolidated the new information gleaned throughout the Project, leading to an update of the 2013 Regional Strategy and Action Plan for Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture. This strategy and action plan is intended to serve as a guide for regional climate change adaptation and disaster risk management in fisheries and aquaculture over the next ten years.

This document is one of several CRFM publications and consultant reports, representing the various outputs of this Project. The list of major report deliverables is as follows.

- CRFM (2019). Research Paper Collection Volume 8. 104 pp. The volume contains 2 research study reports covering surveys of stakeholder knowledge, attitudes, and practices.
  (i) Eyzaguirre, J. Campbell, D., Gardiner, A-G., and Burrowes, R. Towards Climate-Smart Practices Across the Fish Value Chain: Knowledge-Attitudes-Practice Study (p 1-82).
  (ii) Eyzaguirre, J. Litt, A., and Gardiner, A-G. Raising Awareness of Climate Change, Its Impacts and Ways to Adapt in the Caribbean Fisheries Sector: Short-term Effects of Project Communications (p 83-106).
- CRFM (2019). Research Paper Collection Volume 9. 281 pp. The volume contains 5 research papers.
  (i) Eyzaguirre, J. and Tamburello, N. Synthesis, p 1-9.
  (ii) Cheung, W. L., Reygondeau, G., Wabnitz, C.C.C., Tamburello, N. and Singh-Renton, S. A. Climate Change Effects On Caribbean Marine Ecosystems and Fisheries: Regional Projections, p 10-97.
  (iii) Cheung, W. L., Reygondeau, G., Wabnitz, C.C.C., Tamburello, N., Singh-Renton, S. and Joseph, A. B. Climate Change Effects On Caribbean Marine Ecosystems and Fisheries: National Projections for 6 Pilot Countries: Jamaica, Haiti, Dominica, St. Lucia, St. Vincent and The Grenadines, and Grenada, p 98-172.
  (iv) Boyd, R. and Ryan, J. C. Economic Consequences of Climate Change For The Fisheries Sector In Six Caribbean Countries, p 173-251.
  (v) Khan, A.S., Campbell, D., Singh-Renton, S., Murray, A. and Eyzaguirre, J. D. Toward Climate-Smart Value Chains in Caribbean Fisheries, p 252-281.
- CRFM. (2019). Stakeholder Engagement and Communication Strategy and Action Plan (SECSAP) under Work Package 3 of the Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System Project. March 2019. CRFM Technical & Advisory Document, No. 2019/15.
- CRFM. (2019). Report on the Implementation of the Stakeholder Engagement and Communication Strategy and Action Plan (SECSAP) under Work Package 3 of the Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System Project. December 2019. CRFM Technical & Advisory Document, No. 2019/16.
- CRFM (2019). A Guide to Selected Communications Products. CRFM Technical & Advisory Document, No. 2019/16, Suppl. 1. 96pp.
- CRFM (2019). CRFM Portal - User and Administrator Guide. CRFM Technical & Advisory Document, No. 2019/17. 38pp.
- CRFM (2019). Report on Outcomes of the Regional Training Program on Analytical Tools, Monitoring Tools and an Environmental and Fisheries Data Portal. CRFM Technical & Advisory Document, No. 2019/18. 24pp.
- CRFM (2019). Analytical Tools and Monitoring Guidance for Measuring Climate Change Impacts. CRFM Technical & Advisory Document, No. 2019/19. 144pp.
- CRFM (2020). Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture in the CARICOM Region. Regional Strategy and Action Plan 2020-2030. CRFM Technical & Advisory Document, No. 2020/02. 79 pp.
- CRFM (2020). Final Technical Report: Fishery-Related Ecological and Socio-Economic Impact Assessments and Development of an Associated Monitoring System. CRFM Technical & Advisory Document, No. 2020/03. 134pp. The FTR, which is the present report, includes the following as Annexes.
  - Terms of Reference for Conduct of Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System Project.
  - ESSA Technologies Ltd. and collaborators. (2018). Inception Report. Fishery-Related Ecological and Socio-Economic Assessments of the Impacts of Climate Change and Variability and Monitoring System project.
  - ESSA Technologies Ltd. and collaborators. (2018). Report of the Regional Planning Workshop of the Caribbean PPCR Fishery-Related Ecological and Socio-Economic Assessments of the

Impacts of Climate Change and Variability and Monitoring System project, Kingstown, St. Vincent and the Grenadines, 25-26 April 2018.

- Pilot Study Sites

ABBREVIATIONS AND ACRONYMS

CARICOM	Caribbean Community
CCCCC	Caribbean Community Climate Change Centre
CRFM	Caribbean Regional Fisheries Mechanism
FTR	Final Technical Report
IADB	Inter-American Development Bank
KAP	Knowledge Attitudes Practice
MCP	Maximum Catch Potential
MORI	Mona Office for Research and Innovation
PPCR	Pilot Programme for Climate Resilience
SECSAP	Stakeholder Engagement, Communication Strategy and Action Plan
TAC	Technical Advisory Committee
ToR	Terms of Reference
UWI	University of the West Indies
WP	Work Package

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1. INTRODUCTION

Marine biodiversity, ecosystems, and fisheries provide sustenance and livelihoods critical to human well-being in island and coastal communities globally and in the Caribbean region. In the Caribbean, the fisheries sector is economically, socially and culturally important. As such, there is an urgent need to improve understanding of climate change risks and potential impacts to the sector, as well as options to enhance climate resilience. The Inter-American Development Bank has invested in supporting the region's climate resilience, through grant funding for the Caribbean Regional Track of the Pilot Programme for Climate Resilience (PPCR). The "*Fishery-Related Ecological and Socio-Economic Assessments of the Impacts of Climate Change and Variability and Development of an Associated Monitoring System"* project ("the Project") delivers on the Investment Plan of the Caribbean Regional Track of the PPCR. The Project was executed by the Mona Office for Research and Innovation (MORI) at the University of West Indies at Mona, Jamaica, co-implemented by the Caribbean Regional Fisheries Mechanism (CRFM), with technical assistance provided by a consulting team led by ESSA Technologies Ltd. (ESSA).

The Project began in January 2018 and was originally due to run 24 months, but was subsequently extended to April 2020.

This document is the Final Technical Report, in fulfilment of requirements for the fifth deliverable of the Terms of Reference (see Annex I), and summarizes the consultant's activities under the assignment and provides broad recommendations stemming from the technical work. The Team Leader of the ESSA consulting team authored this document, drawing from previous project deliverables, as needed.

2. OBJECTIVES, SCOPE AND EXPECTED RESULTS

As noted in the Terms of Reference the general objective of the consulting assignment was to:

- Improve the information base and its usage for climate-smart fisheries planning and management decision-making, as well as, risk management in the fisheries sector.

Specific objectives were as follows:

- The conduct of ecological and socio-economic assessments of the impacts of climate change and variability on the fisheries resources and sector;
- Developing and implementing suitable analytical tools and methods for fisheries and marine ecosystem analyses and assessments to quantify the impacts of climate change and variability on fisheries production, post-harvest and marketing systems and associated livelihoods and to predict likely future impacts and provision of training in use of the tools and methods;
- Developing a fisheries and environment database and the associated meta-database, as well as, the supporting database manual and data and information policy and provision of training on database management/usage; and
- Development and implementation of a stakeholder engagement proposal to build stakeholder awareness on the impacts of climate change and variability on the fisheries resources and sector, and to engage stakeholders in identifying feasible recommendations for climate-smart fisheries management decision-making.

The geographic scope of the project was regional but with research and engagement activities focused on the six countries with national PPCR programs: the Commonwealth of Dominica, Grenada, Haiti, Jamaica, Saint Lucia, and Saint Vincent and the Grenadines (SVG).

The scope of services comprised a series of activities corresponding to four Work Packages (WP): assessment; climate-smart fisheries monitoring system; stakeholder engagement and communications; and integration of climate risk and resilience into regional fisheries development and planning.

Key activities and outputs expected under each WP were as follows:

WP1: Planning and Assessment

- Inception meeting and report
- Regional planning workshop
- Climate change impact assessments (ecological, economic, value chain analysis)

WP2: Climate-Smart Fisheries Monitoring System

- Analytical tools to support impact assessment and adaptation planning
- Fisheries and environmental database with associated manual (CRFM data portal)
- Regional training workshop

WP3: Stakeholder Engagement and Communications

- Knowledge-attitudes-practice study
- Stakeholder engagement and action plan
- Multi-media outreach materials
- Communications campaign and measurement of its effect

WP4: Integration of Climate Risk and Resilience in Fisheries Development and Planning

- Updated Regional Strategy and Action Plan for Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture

Aside from expectations regarding the scope of work and related deliverables the ESSA consulting team also considered in project delivery the following indicators of project success:

Process

- A project process that includes high level of meaningful consultation with stakeholders from the 6 PPCR countries
- Project outputs that are nationally-relevant with potential for regional applicability
- A high potential for sustainability of results in the absence of CRFM support

Outcome

- Increased information available on climate change impacts on fisheries and resilience options
- Increased understanding by technical, policy and industry / fisher folk of climate change impacts on fisheries and resilience options

3. ACTIVITIES UNDERTAKEN

Inception activities. Between January and February 2018, the ESSA consulting team undertook three types of inception activities that served three main purposes: understanding CRFM's needs and expectations for the project, as well as extent of support to be provided; advancing scoping decisions; and cultivating trust among members of the consulting team. The inception activities comprised two virtual meetings and follow-up email correspondence with the CRFM client; at least nine virtual meetings with different configurations of the consulting team; and a review of literature and online publications and databases. These meetings and the insights gleaned from reviewing easily-accessible information fed into the scoping considerations and new information on methods, sequencing and timing of activities reflected in the Inception Report, submitted in February 2018 and finalized in March 2018. This Report included preliminary agenda items

for a subsequent Regional Planning Workshop and a process to select pilot sites where local, primary data collection would take place. The Inception Report is given in Annex II.

Regional planning workshop. To mark the official launch of the Project, initiate engagement with project stakeholders and elicit input to scope discrete project activities, a Regional Planning Workshop was held in Kingstown, St. Vincent and the Grenadines, 25 to 26 April 2018. The workshop brought together 12 representatives from the six countries with PPCR initiatives, the CRFM Secretariat and members of the ESSA consulting team delivering the project. Five objectives shaped the workshop agenda and task processes: (1) develop a shared understanding of the pathways of climate change impact on ecological and socio-economic components of two fisheries systems (reef, mangrove / seagrass and pelagic ecosystems); (2) clarify the purpose and functions of a climate-smart fisheries monitoring system and related fisheries and environment database; (3) discuss options and select pilot study sites for local project activities; (4) strengthen communication goals around knowledge, awareness and practice on climate adaptation and disaster risk reduction responses within the Caribbean fisheries sector; and (5) Establish a CRFM PPCR Project Working Group. This workshop helped clarify the species to be included in the ecological modelling, the climate change impacts on which to focus on in the economic impact assessment, the potential needs and functions expected for a regional fisheries and environmental database and target audiences for communications and outreach activities. As a result of the workshop a Regional Project Working Group was initiated, with a corresponding DGroup and calendar of virtual meetings. The report of the Regional Planning Workshop is given in Annex III. Due to time constraints, approval of the selection of pilot sites was undertaken via email, subsequent to the workshop (see Annex IV).

Work Package 1

Assessment and value chain analysis. Following the inception phase of the project, technical work under WP1 commenced. Data collection began in June 2018 and the final technical reports were approved by the CRFM Secretariat in June 2019.

Assessing the ecological impacts of climate change on Caribbean fisheries to the 2050s, using two contrasting scenarios of global greenhouse gas mitigation (business as usual and deep cuts) involved data collection, initial modelling and validation. Data collection involved variables that define the marine environment obtained as outputs from global models (e.g., surface and bottom seawater temperature, oxygen concentration, salinity and net primary production); occurrence, life history (e.g., age at maturity, thermal optima) and ecological data (e.g., depth) associated with the species in scope; and, time series of fisheries catch data associated with the 110 species in scope. Three different modelling approaches were used to derive current and projected community-level indices of impacts (species invasion, extinction and turnover) as well as change in maximum catch potential (MCP) at a basin scale and for important commercial species. The first model runs were presented to the project's Regional Technical Advisory Committee (TAC) in November 2018, which included representatives from the Project Management Unit, the Caribbean Regional Fisheries Mechanism (CRFM), the UWI Climate Studies Group, the Caribbean Institute for Meteorology and Hydrology, among others. The work was well received but the TAC emphasized the importance of validating modelling outputs with national experts. The consulting team shared modelling outputs (maps) representing habitat suitability with fisheries officers from all six focal countries, requesting that they highlight areas that species of national interest should/should not occur, or should have high/low habitat suitability. Feedback was received from CRFM Secretariat, Haiti and Saint Lucia. A draft technical report included modelling results in a regionally-focused chapter and a nationally-focused chapter; it was sent for CRFM Secretariat and stakeholder review in March 2019, with a substantially-revised version submitted for final review in June 2019.

Analysis of the economic consequences to fisheries sectors of climate change impacts on landings to 2050s and 2080s using two global emissions scenarios followed a similar sequencing. The team assembled

economic (e.g., gross domestic product, seafood consumption / production), trade (imports / exports of seafood), landings (weight and value of seafood for 6 species groupings), human population, historical tropical cyclone and sea surface temperature data. MCP results derived from the ecological modelling work were converted into % reductions in landings by main species groups by emissions scenario and time period. We used two approaches to model the economic impacts at a national level, covering impacts from reduced landings due to climate-change induced ecological shifts and impacts from enhanced storm activity. The economic impacts of climate-induced changes in fishery production (landings) were assessed using a market supply-demand model developed for each of the six case study countries. This approach is based on theoretical concepts of traditional welfare economics, which seek to explore how the allocation of resources affects well-being of producers and consumers in an economic system. The impacts of climate change are integrated into the modelling framework as a supply shock. The storm analysis simulates the economic impact of a 'what if' scenario: if all else is equal (historical catches, prices, adaptation, etc.), what if the same sample of storms reoccurred but with higher intensities anticipated with warming sea surface temperatures. To improve the quality and relevance of modelling outputs the consulting team requested PPCR countries to validate input data (e.g., annual fishery production, trade) used in the fish demand-supply models, with feedback received from Jamaica, Saint Lucia, Saint Vincent and the Grenadines and Grenada. Reporting followed the same schedule as the ecological assessment work.

We used qualitative research methods to understand the socio-economic adaptive capacity and response of the fishing sector to climate risk across the three production stages of the fish chain (pre-harvest, harvest, post-harvest). Primary data collection in wild captured coastal and marine fisheries took place in two pilot study sites between April and June 2018: Kingstown (Saint Vincent and the Grenadines) and Montego Bay (Jamaica). We used a standard interview guide to complete about 50 key informant interviews; in all primary data collection involved 24 fishers (inshore and offshore), 12 stakeholders in processing, marketing, and retail activities, and 14 individuals with roles in fisheries and marine resource management, economic planning, tourism development and recreational fisheries, environmental planning and climate change adaptation. Research planning, coordination and reporting on results involved close cooperation with the CRFM Secretariat and fisheries officers from Jamaica and Saint Lucia and therefore the individuals involved are co-authors of the published study.

Outputs of WP1 are included in the following publication:

- CRFM (2019). Research Paper Collection Volume 9. 281 pp.

Mapped outputs of ecological modelling and Excel spreadsheets underlying the economic analysis are available on the CRFM data portal.

Work Package 2

Data portal and other tools. Initial scoping of this tool and broader monitoring needs took place during the two-day regional planning workshop in SVG in April 2018. Structured discussions and a follow up survey with regional workshop participants helped identify monitoring questions of interest to regional stakeholders, potential indicators, existing marine and fisheries monitoring (project-based, nationally or regionally), technology and implementation issues that could hinder the longevity of new database tools in support of monitoring. The team concluded that the most sustainable contribution to supporting scientific advancements in the region consisted of a user-friendly information repository, tools to replicate and update the project's analyses, tiered monitoring guidance, and a simple database for managing core climate-smart monitoring results. Site visits to Dominica and SVG in July 2018 and situational assessments of monitoring and fisheries management completed in November 2018 further validated low levels of monitoring capacity and information management capabilities, confirming the relevance of our approach, and design of the database tool began, using the CKAN data portal platform (https://ckan.org). The TAC meeting in November 2018 also confirmed the relevance of the approach.

Design of the data portal proceeded in early 2019, with a beta version available for exploring and testing in February 2019. Between March and August 2019, the project team populated the data portal with project outputs and created a metadata library. Securing transfer of operations, management and hosting responsibilities to the CRFM was critical to ensure this database tool could serve the region's scientific needs beyond project closure. A regional workshop held in October-November 2019 included two training modules for both users and eventual administrators of the data portal, which identified a few bugs to address and validated the tool's potential to improve information sharing across the region. The online data portal was transferred to CRFM in December 2019 (http://portal.crfm.int/).

While the results of modelling-based assessments provide a useful foundation for adaptation planning, regional monitoring data are needed to better tailor adaptation to local contexts and enable continued adjustments within an adaptive management approach. Starting in October 2018 the ESSA consulting team set out to develop a climate change and fisheries monitoring framework tailored to the needs of the region. Building on an assessment of the current fisheries monitoring occurring in the six focal countries, we formulated a series of Big Questions. The Big Questions articulated key uncertainties in plain language and were used to guide monitoring priorities related to the physical and ecological dimensions of climate-smart fisheries; finalization of the questions required feedback from the CRFM Secretariat and national fisheries officers at several iterations to ensure their relevance. For each big question, we identified indicators and metrics relevant to major climate-ecological impact pathways within the qualitative conceptual models developed during an earlier phase of the project. Finally, we developed guidance for survey and sampling design for the indicators and metrics and included suggestions for analyses of the resulting monitoring data in the context of fisheries decision-making. All of this monitoring guidance is collated into a series of quick-reference Monitoring Cards that synthesize key considerations for answering each of the big questions. A technical report which presents this monitoring guidance also includes analysis tools (R code for species distribution modelling and a user guide for the market supply-demand fisheries models), discussions on adaptation options, prioritization criteria, and marine spatial planning, which we developed through literature review and elicitation of knowledge from project stakeholders. The results of these discussions were used as inputs for in-person training and review sessions in the Regional Training Workshop held in Rodney Bay, Saint Lucia in October-November 2019.

Training. As mentioned above, an important activity under WP2 was the delivery of training. The ESSA consulting team, in collaboration with the CRFM Secretariat, planned and implemented a five-day training Regional Training Workshop in Rodney Bay, St. Lucia, from October 28 to November 1, 2019. This workshop was the Project's second and final major face-to-face activity. It brought together 14 individuals in total, including members of the CRFM Secretariat, fisheries officers from PPCR countries (Dominica, Grenada, Jamaica, Saint Lucia and Saint Vincent & the Grenadines), a representative from Project's TAC and a representative of the Climate Studies Group at UWI. Consistent with the ToRs for the Project, workshop objectives were as follows:

- To introduce assessment, monitoring and decision-support guidance and tools developed under the Project to enable climate-smart decision-making in fisheries;
- To build knowledge and skills for use of the guidance and tools by fisheries officers from PPCR countries;
- To introduce the fisheries and environment online data portal developed under the Project (i.e., the CRFM Data Portal);
- To build knowledge and skills for the use, management and long-term maintenance of the data portal.

Designed based on principles of adult education, the training workshop consisted of a mix of delivery formats, including lectures, demonstrations, individual exercises, exercises in pairs and small groups and practical application of theoretical concepts. By all accounts the training workshop achieved its stated

objectives, with participants almost unanimously concluding that the training offered data and information resources, knowledge and tangible skills to support them in their efforts to advance climate change adaptation in fisheries.

Outputs of WP2 are included in the following publications:

- Analytical Tools and Monitoring Guidance for Measuring Climate Change Impacts. CRFM Technical & Advisory Document, No. 2019/19. 144pp.
- CRFM (2019). CRFM Portal - User and Administrator Guide. CRFM Technical & Advisory Document, No. 2019/17. 38pp.
- CRFM (2019). Report on Outcomes of the Regional Training Program on Analytical Tools, Monitoring Tools and an Environmental and Fisheries Data Portal. CRFM Technical & Advisory Document, No. 2019/18. 24pp.

Work Package 3

Outputs of the detailed science assessments are of limited value unless this information translates into action. WP3 focused on communications and engagement activities, seeking to identify creative ways to communicate the science of climate change, how climate change is affecting the natural and human environment, and what broad strategies are available to adapt and to make this information relevant and readily accessible to fisheries sector stakeholders. Activities under this work package included: i) scoping target audiences for communications and stakeholder engagement, ii) completing a Knowledge-Attitude-Practice (KAP) study informed by primary data, iii) developing a Stakeholder Engagement and Communications Strategy and Action Plan (SECSAP) informed by KAP study results and iv) operationalizing the SECSAP via a communications campaign.

Scoping: Discussions during and at the margins of the Regional Planning Workshop in Kingstown in April 2018 helped narrow down target audiences for activities under this work package. Target audiences were as follows: fisherfolk (harvesters and other value chain actors), technocrats / fisheries officer ("fisheries intermediaries") and policy actors (Fisheries Ministers/ CRFM led-Ministerial Council and other Cabinet members). Workshop discussions also provided ideas on outreach and communications products to develop.

KAP Study: This study was undertaken to measure knowledge levels, prevailing attitudes and behavioural practices relating to adaptation to climate change and disaster risk reduction among a sample fisherfolk, policy actors and fisheries intermediaries. The KAP Study employed different approaches to reach the three audiences, with data collection taking place from June to September 2018. We deployed and analyzed the results from 161 questionnaires directly administered to fisherfolk by trained assessors in three fishing communities: Montego Bay (Jamaica), Kingstown (St. Vincent and the Grenadines) and Roseau (Dominica). We completed in-depth interviews over the telephone or Skype with four senior-level fisheries authorities in government. We deployed and analyzed results from a self-administered online questionnaire, which was completed or partially completed by 28 sectoral representatives in managerial-level roles. Aside from measuring and reporting on levels of climate change knowledge, attitudes on climate change as a salient issue and use of information and other measures to adapt to climate hazards, the KAP Study summarized perspectives on i) perceived climate change risk, ii) the feasibility and importance of a range of adaptation measures and iii) preferred formats and media to reach fisherfolk for climate change communications. The first draft of the KAP Study was prepared in November 2018 and, after significant revisions based on CRFM Secretariat feedback, was finalized in March 2019.

Stakeholder Engagement, Communication Strategy and Action Plan (SECSAP): We developed the SECSAP as a cross-cutting tool to guide the Project's communication activities. The document outlined (1) communication goals and objectives, (2) target audiences, (3) a methodology that links communication

activities to expected results and (4) an implementation plan with information on specific activities and timelines. Communication needs and opportunities identified in the SECSAP were identified through a three-stage process: consultations with Project partners during the inception phase (January to April 2018), a desk review of foundational documents on climate change and fisheries in the Caribbean and the KAP Study. All Project activities and investments in this work package and on communications of science and assessment findings overall were designed to contribute to the following communication objectives:

- To increase knowledge among fisherfolk of the link between climate change adaptation and improved livelihoods prospects.
- To improve climate change communication and advocacy skills of Fisheries Officers/ Managers.
- To increase awareness of climate impacts on fisheries and encourage greater personal and collective responsibility and action.

The first draft of the SECSAP was prepared in November 2018, with subsequent revisions in January 2019, February 2019, and finalized in March 2019.

Communications Campaign: The communications campaign took place between April and November 2019. It comprised the development of four posters, a video-documentary (in English and Haitian Creole) and accompanying discussion guide, outreach materials for fisheries intermediaries and news articles. Dissemination of these communication products relied on a number of channels to maximize reach cost-effectively; channels included a WhatsApp contact group and technical dispatches by the CRFM to country members. The table below outlines our key communication activities by audience and communication objective.

Audience and objectives	**Communication activities**
1. To increase knowledge among **fisherfolk** of the link between climate change adaptation and improved livelihoods prospects	• Design of four posters with simple messages on changes in the ocean environment, impacts on fisherfolk and concrete actions to adapt (English and Haitian Creole • Dissemination of the "Our Sea is Changing" posters via WhatsApp to a list of fisherfolk, coupled with a brief survey questionnaire to determine if and how their level of knowledge improved • Dissemination of posters as part of CRFM activities (online and offline), and the wider PPCR Regional Communications Initiative • Announcement of the suite of project communications products via a news article distributed by CRFM
2. To improve climate change communication and advocacy skills of **fisheries officers/ managers ("fisheries intermediaries")**	• Delivery of a training module on climate communications, highlighting the suite of project communications products: posters, video documentary, Power Point modules on climate change science, vulnerability concepts, results of ecological and economic assessments of climate change impacts, results of value chain analysis
3. To increase awareness of climate impacts on fisheries and encourage greater personal and collective responsibility and action across the sector (**policymakers and general public**)	• Development of the video documentary "Fish for Today and Tomorrow" (English and Haitian Creole) and accompanying discussion guide, making it available for viewing / downloading via YouTube, the CRFM and PPCR websites. The film was also screened at CineFish at the Gulf and Caribbean Fisheries Institute conference in November 2019

Throughout the campaign the project team sought to gather stakeholder feedback on the communication products and on their knowledge and attitudes toward climate change and fisheries. This feedback was

provided as responses to a simple online survey. To boost the response rate and recognize the costs of participation, the project offered an incentive of phone credit 10 XCD or its equivalent to encourage fisherfolk to complete and submit the survey. This was a one-time credit sent to the fisher once a completed survey had been submitted, limited to one submission per phone number. In total 40 surveys were completed by fisherfolk and 14 by fisheries intermediaries. Feedback from fisherfolk and fisheries intermediaries suggests that the communication products developed by the Project are relevant, salient and credible; they are available for future public outreach. The ESSA consulting team reported on the implementation of the SECSAP in December 2019.

Outputs of WP3 are included in the following publications:

- CRFM (2019). Stakeholder Engagement and Communication Strategy and Action Plan (SECSAP) under Work Package 3 of the Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System Project. March 2019. [Published by CRFM as "Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System: Stakeholder Engagement and Communication Strategy and Action Plan, CRFM Technical & Advisory Document No. 2019 / 15"].
- CRFM (2019). Report on the Implementation of the Stakeholder Engagement and Communication Strategy and Action Plan (SECSAP) under Work Package 3 of the Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System Project. [Published by CRFM as "Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System: Implementation of the Stakeholder Engagement and Communication Strategy and Action Plan, CRFM Technical & Advisory Document No. 2019 / 16].
- CRFM (2019). Research Paper Collection Volume 8. 104 pp.

In addition, communication products are available for download on the CRFM website and data portal, as well as the Caribbean Regional Track PPCR website. Current locations of these products are below.

Video documentary: Fish for Today and Tomorrow Part 1.
[https://www.youtube.com/watch?v=w1H6dxd7Zik]
Video documentary: Fish for Today and Tomorrow Part 2.
[https://www.youtube.com/watch?v=SvpmTLVEv4c]
Video documentary: Fisher for Today and Tomorrow Part 1 (Haitian Creole subtitles)
[https://www.youtube.com/watch?v=q9K6TicAVJ0]
Video documentary: Fisher for Today and Tomorrow Part 2 (Haitian Creole subtitles)
https://www.youtube.com/watch?v=e_CQVx2ykpM
A Guide to Selected Communications Products
[Published as CRFM Technical & Advisory Document No. 2019/16, Suppl. 1. https://www.crfm.int & CRFM Portal http://portal.crfm.int/]

Posters
English versions
Our Sea is changing and we must change with it (Fishers – fisheries management)
[http://www.crfm.int/images/Poster_-_Fishers_-_management_English.pdf]
Our Sea is changing and we must change with it (Vendors/fish sellers).
[http://www.crfm.int/images/Poster_-_Vendors_English.pdf]
Our Sea is changing and we must change with it (Consumers/householders).
[http://www.crfm.int/images/Poster_-_Consumers_English.pdf]
Our Sea is changing and we must change with it (Fishers – fishing gear).
[http://www.crfm.int/images/Poster_-_Fishers_-_fishing_gear_English.pdf]

Haitian Creole versions

Lanme nou an ap chanje se pou nou chanje avek li tou (Fishers – fisheries management)
http://www.crfm.int/images/Poster_-_Fishers_-_management_Haitian_Creole.pdf
Lanme nou an ap chanje se pou nou chanje avek li tou (Vendors/fish sellers)
http://www.crfm.int/images/Poster_-Vendors_Haitian_Creole.pdf
Lanme nou an ap chanje se pou nou chanje avek li tou (Consumers/householders).
http://www.crfm.int/images/Poster_-_Consumers_Haitian_Creole.pdf
Lanme nou an ap chanje se pou nou chanje avek li tou (Fishers – fishing gear).
http://www.crfm.int/images/Poster_-_Fishers_-_fishing_gear_Haitian_Creole.pdf

Posters are also available at http://portal.crfm.int/dataset/our-sea-is-changing-we-must-change-with-it-climate-change-posters

PowerPoint Modules
Module 1 – Climate Change
Module 2 – Fisheries Sector Vulnerability to Climate Change – Concepts and Project Overview
Module 3 – Ecological and Economic Impacts of Climate Change on Caribbean Fisheries
Module 4 – Adaptive Capacity of Caribbean Fisheries Sector

PowerPoint Modules are available at http://portal.crfm.int/dataset/powerpoint-presentation-modules]

Work Package 4

The main output of this work package was an updated Regional Strategy and Action Plan for Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture, accounting for new information stemming from Project outputs as well as the aspirations and capacities of Caribbean stakeholders across the fish value chain. During year 1 of the Project we sought to undertake a desk-based stock take of the extent of progress in implementing the regional strategy and lessons learned as a result. We focused on tracing delivery against actions deemed to be high priorities for coastal and marine systems and fisheries and aquaculture in the 2013 regional strategy. However, the lack of centralized reporting and sheer number of actions to investigate (by our count 44 high priority actions) made it difficult to carry out this exercise efficiently and generate accurate results from web-based searches alone. WP4 activities picked up again in November 2019; we dedicated a module into the Regional Training Workshop to elicit participants' views on the strategic elements and actions where most and least progress had been made since 2013. To further complement this feedback, we developed and deployed an online survey, distributed to representatives of CRFM member countries by the CRFM Secretariat in December 2019. We compiled and analyzed results in January 2020 and worked with the CRFM Secretariat to develop an outline of the updated strategy and action plan in the same month. This document is a sector-level interpretation of the 2019 *"Climate Change and the Caribbean: A Regional Framework for Achieving Development Resilient to Climate Change (2019-2029)"*. In addition to stakeholder feedback and expert judgment of the ESSA consulting team we performed a literature review and delivered a draft and revised regional strategy and action plan in April 2020.

The only output of WP4 is the following publication:

- CRFM (2020). Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture in the CARICOM Region: Regional Strategy and Action Plan 2020-2030. CRFM Technical & Advisory Document, No. 2020 / 02. 79 pp.

4. TECHNICAL AND DELIVERY CHALLENGES

The Project successfully delivered on the Terms of Reference and we are proud of the range and quality of outputs generated. Nevertheless, as with any technical assistance project of a multi-faceted nature the team did experience delivery challenges and two of them are worth noting. They relate to engagement of national stakeholders and delays with WP3. Both challenges pose threats to the sustainability of project results.
One of our indicators of success drew attention to a project process with high levels of meaningful consultation with stakeholders from the six PPCR countries. Indeed, the importance of sustained national engagement throughout the project was recognized by the CRFM Secretariat, who took several actions to facilitate consultation and engagement. These actions included requesting that each country identify a national fisheries liaison officer (plus an alternate) to engage in Project activities throughout the two years, supporting the running of the Regional Project Working Group (via access to the DGroups platform, for example) and advising the ESSA consulting team on remote engagement options that could yield the best results (e.g., official request for written feedback versus a webinar). Although feedback on interim technical outputs as well as support in carrying out primary data collection in local fishing communities was forthcoming to an extent, engagement by PPCR country representatives was uneven. As well, the relevance of some technical deliverables could have been heightened with greater, timely access to national government representatives outside the fisheries sector (for example, to validate macro-economic and trade statistics to inform the market fisheries supply-demand models). Finally, we observed little response from CRFM member countries (beyond the six PPCR countries) to the CRFM Secretariat's requests for comment on official project deliverables.

Relative to the original delivery schedule, the ESSA consulting team experienced significant delays in carrying out communication-related activities under WP3. Completing the KAP study took longer than expected, as we missed a window of availability for field work by the Social Scientist on our team. These delays then had knock-on effects on the production of subsequent deliverables. Delays were within the control of the ESSA consulting team to manage but we experienced bottlenecks in the work flow, given the Team Leader's need to coordinate and integrate across activities underway under three different work packages. As a result of these delays, the duration of the communication campaign was significantly shorter than envisioned, leaving less time to raise awareness and support application of the knowledge products developed.

5. RECOMMENDATIONS

Several deliverables include specific recommendations on communicating impact assessment results, sustaining results achieved through Project training and supporting adaptation planning in the region's fisheries sector. The 2020 Regional Strategy and Action Plan itself embeds recommendations of the ESSA consulting team within a series of priority goals and action items. Here, we offer broad recommendations on project design and immediate next steps that would drastically improve the sustainability of results stemming from this Project.

As the region and CARICOM member countries seek technical assistance and support to advance climate resilience of the sector and the Blue Economy development model, including initiatives focused on marine spatial planning and ocean governance reforms, CRFM, its member countries and development partners would do well to consider the following recommendations:

- Bundle projects such that the multi-dimensional nature of fisheries sustainable development issues is retained. The integration of different disciplines and combination of skills required to deliver on the Project greatly contributed to the Project's success. Each work package could have been its own technical assistance project. However, it was the knowledge transfer and ability to coordinate inputs and

outputs across work packages that yielded efficiencies in our delivery and supported the generation of robust knowledge products (e.g., simple messages on posters jointly developed by marine ecologists, a social scientist and a communication expert). Another ingredient for success is having a client contact (in our case Dr. Susan Singh-Renton at the CRFM Secretariat) who is technically / scientifically skilled and a strategic thinker.

- Project design should consider the timelines and resources needed to support meaningful engagement of project stakeholders. In our case, it would have been helpful to lead at least one regional face to face event per work package, share responsibility for the success of each event with national fisheries representatives and integrate study tours and visits to fish landing sites, markets and major processing operations. In addition, greater reliance on and bigger roles for local experts based in the region could have improved engagement in between major regional milestones. For example, team members based in PPCR countries could have convened stakeholders to prompt their feedback on interim project deliverables. At the same time, the COVID-19 pandemic is heightening the need to improve capacities to both host and participate in remotely-facilitated sessions. Executing agencies (in our case MORI-UWI) could play a role in extending access to IT platforms to locally-based project partners.

Finally, to increase the long-term success of the Project we recommend the following actions on a priority basis:

- Continue to disseminate knowledge products generated under WP1 and WP3, this includes giving these products high visibility on websites of project partners, integrating these products into presentations and other day-to-day work of the CRFM.

- Ensure the CRFM Secretariat has the capacity to continue to host and promote the use of the CRFM data portal. The data portal is user friendly but it needs to be maintained and promoted so that traffic is generated and countries and organizations in the region continue to use the tool to share key datasets and information to support climate change adaptation in the fisheries sector.

- Make resources available to provide refresher training on the basics of R coding and QGIS. The Regional Training Workshop in October-November 2019 included basic tutorials on these tools and several participants saw value in continuing to hone skills in their use. Augmenting capacities within fisheries departments to use R for statistical analysis and modelling and QGIS for mapping and overlay analysis would be a great achievement for the region. It would support use and repurposing of Project outputs beyond the six PPCR countries.

ANNEX I: TERMS OF REFERENCE

ATN/SX-14969-RG
Conduct of Fishery-related Ecological and Socio-economic Impact Assessments and Development of an Associated Monitoring System
Terms of Reference

1. Background

1.1. The Pilot Program for Climate Resilience (PPCR) was designed under the Strategic Climate Fund (SCF), in response to the urgent need to scale up investments in climate risk and resilience measures for highly vulnerable countries, to pilot and demonstrate ways to integrate climate risk and resilience into their core development planning. The PPCR is intended to support the mainstreaming of climate risk resilience in the development policies and strategies of developing countries mainly through the following:

i. Piloting and demonstration of approaches for the integration of climate risk and resilience into development policies and planning;
ii. Strengthening of capacities at the national levels to integrate climate resilience into development planning;
iii. Scaling-up and leveraging of climate resilient investment, building upon other ongoing initiatives;
iv. Enabling learning by doing and lesson sharing at the country, regional and global levels and;
v. Strengthening cooperation and capacity at the regional level to integrate climate resilience in national and appropriate regional development planning and processes.

1.2. The Caribbean Pilot consists of a regional approach that proceeds along two closely linked and complementary tracks:

i. National PPCR – Country based investments in six highly vulnerable nations – Commonwealth of Dominica, Grenada, Haiti, Jamaica, Saint Lucia, and Saint Vincent and the Grenadines;

ii. Regional PPCR – Region-wide activities including data management and monitoring for improving understanding of climate risks and potential impacts, as necessary to take actions to enhance climate resilience, coupled with activities to tackle risks and vulnerabilities common to all Caribbean countries.

1.3. Each of these countries has a national program of activities which is outlined in a Strategic Program for Climate Resilience (SPCR). The regional track of activities is also defined in a Caribbean Regional SPCR. The Investment Plan for Caribbean Regional Track of the PPCR (IPCR) arose from this and is designed to work through key entities in the Caribbean region to provide the scientific analysis so that countries can incorporate climate resilience into their national climate change strategies as well as in regional planning strategies, policies and financing mechanisms. One of these key entities is the Caribbean Regional Fisheries Mechanism (CRFM) which is the co-implementer and direct beneficiary of this procurement. The two tracks (national and regional) will thus be synergistic – the regional activities will supplement and strengthen the country-led programs and activities and also extend public good benefits and lessons learned from the pilot program to all Caribbean Community (CARICOM) member countries.

1.4. The Mona Office for Research and Innovation (MORI) as the executing entity for the IPCR is seeking to improve the information base for climate-smart fisheries planning and management decision-making as well as risk management in the fisheries sector. To this end, a Consultant is required to conduct fishery-related ecological and socio-economic impacts assessments of the impacts of climate change and variability and to develop an associated monitoring system. This consultancy will also include awareness-building of

stakeholders on the fishery-related impacts of climate change and their participation in identifying feasible management measures for disaster risk management in the sector, as well as training on use of the monitoring system.

2. **Objective(s) of the Assignment**:

2.1. The general objective of the consulting services it to improve the information base and its usage for climate-smart fisheries planning and management decision-making, as well as, risk management in the fisheries sector.

2.2. Specific objectives include:
i. The conduct of ecological and socio-economic assessments of the impacts of climate change and variability on the fisheries resources and sector;
ii. Developing and implementing suitable analytical tools and methods for fisheries and marine ecosystem analyses and assessments to quantify the impacts of climate change and variability on fisheries production, post-harvest and marketing systems and associated livelihoods and to predict likely future impacts and provision of training in use of the tools and methods;
iii. Developing a fisheries and environment database and the associated meta-database, as well as, the supporting database manual and data and information policy and provision of training on database management/usage; and
iv. Development and implementation of a stakeholder engagement proposal to build stakeholder awareness on the impacts of climate change and variability on the fisheries resources and sector, and to engage stakeholders in identifying feasible recommendations for climate-smart fisheries management decision-making.

3. Scope of Services, Tasks (Components) and Expected Deliverables

3.1. Consultancy's activities are organized into four (4) Work Packages, which include but are not limited to the following:

i. Work Package 1: Planning and Research Investigations
a) Convene inception meeting with the CRFM Secretariat and PPCR PMU to discuss consultancy requirements (scope of works) and to develop an agreed work plan and implementation schedule;
b) Organize and convene a regional planning workshop to identify management information requirements for climate-smart decision-making, discuss possible analyses, assessments and models to be used, identify the data requirements and data sources, develop criteria for selection of pilot sites for the study, select the pilot sites for the study, discuss elements of an associated fisheries and environment database and related data and information policy and finalize work plan; and
c) Investigate, by research studies, the ecological and socio-economic impacts of climate change and variability on the fisheries resources and sector and prepare the necessary reports.

ii. Work Package 2: Developing a Climate-Smart Fisheries Monitoring System

a) Liaise with the UWI Mona Climate Studies Group, the Caribbean Institute for Meteorology and Hydrology, other regional climate modelers and regional experts in meteorology and hydrology and any other relevant regional institutions, as well as national Fisheries Divisions, to acquire data and information on climate change and variability (observed and predicted), as well as data and information on fisheries, for conducting impact assessments and fisheries and marine ecosystem analyses and assessments;
b) Develop and implement suitable analytical tools and methods for fisheries and marine ecosystem analyses and assessments to quantify the impacts of climate change and variability on fisheries production, post-

harvest and marketing systems and associated livelihoods and to predict likely future impacts, and prepare the necessary reports;
c) Develop, install and test the associated fisheries and environment database to house all inputs and outputs of the consultancy, so as to facilitate follow-up management of the database, assessments and analyses by the CRFM or partner institution designated for the responsibility, taking into account the institution's capacity and commitment for managing the database effectively.
d) Upload all data and information to the database;
e) Develop the associated meta-database, as well as the zero, revised and final drafts of the supporting database manual that incorporate comments provided by the CRFM and other key stakeholders;
f) Provide specifications of any required additional software and equipment for the fisheries and environment database and assisting with sourcing the requisite quotations to facilitate procurement by the PPCR PMU;
g) Organize and convene two workshops to train regional Fisheries Officers and staff of the CRFM Secretariat on use of the tools and methods for (a) conducting fisheries and marine ecosystem analyses and assessments and (b) management and use of the fisheries and environment database.

iii. Work Package 3: Facilitating Stakeholder Access and Contribution to the Information Base for Climate Change Adaptation and Disaster Risk Management in Fisheries

a) Develop a stakeholder engagement and communication strategy and action plan, which should be informed by a suitable stakeholder survey and which would include: the development of suitable stakeholder engagement materials (e.g. brochures, PowerPoint presentations, video documentary and a multi-media library) to build awareness on the impacts of climate change and variability on the fisheries resources and fisheries sector; and, options to engage stakeholders in identifying feasible recommendations for climate-smart fisheries management decision-making;. The Communications Strategy and Action Plan will also serve to improve on the usage of existing CRFM communication and networking tools;
b) Collaborate with designated focal points within national fisheries divisions to implement the agreed stakeholder engagement and communication strategy and action plan as articulated in bullet a. above; and
c) Conduct pre-project survey of the Caribbean Fisheries Forum and Ministerial Council to assess the knowledge, attitudes and practices (KAP) concerning fishery-related impacts of climate change and variability and best practices in disaster risk management in the fisheries sector at this time.
d) Prepare an impact assessment tool for use by the CRFM in determining the longer-term impacts being realized 1-2 years following completion of the assignment.

iv. Work Package 4: Facilitating the Integration of Climate Risk and Resilience into Regional Fisheries Development and Planning

a) Updating the Regional Strategy and Action Plan for Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture to include findings and suggested recommendations for climate-smart fisheries management from Work Packages 1, 2 and 3; and
b) Preparing the draft and final versions of a final technical report, to include the specific technical deliverables listed in part 6 of this Terms of Reference.

3.2. The consultancy is also expected to provide training in the conduct of fisheries and marine ecosystem analyses and assessments and use of the fisheries and environment database and to build stakeholder awareness on the impacts of climate change and variability on the fisheries resources and sector and to engage stakeholders in identifying feasible recommendations for climate-smart fisheries management decision-making.

4. **Team Composition & Qualification Requirements for the Key Experts** (and any other requirements which will be used for evaluating the Key Experts under Data Sheet 21.1 of the ITC)

4.1. The work is expected to be carried out by a consulting firm with at least five (5) years of proven experience assessing the ecological and socio-economic impacts of climate change and climate variability on the fisheries resources and fisheries sector, with specific experience in the conduct of fisheries and marine ecosystem analyses and assessments to quantify past, and predicted, climate change and climate variability impacts on fisheries production, post-harvest and marketing systems and associated livelihoods. The consulting firm is also expected to have at least ten (10) years of experience working with the fisheries sector, addressing issues that include risk management, and to have experience working in data-limited situations. Knowledge of, and experience in, the management of fisheries in Small Islands Developing States, with specific experience in the Caribbean region, are highly desirable.

4.2. The consultants comprising the team may be international or national and should include:
i. One (1) Fisheries and Marine Ecosystem Assessment Expert;
ii. One (1) Natural Resource Economist;
iii. One (1) Climate Change/Climate Variability Expert;
iv. One (1) Fisheries Management Expert;
v. One (1) Database Design and Development Expert;
vi. One (1) Value Chain Management Expert with experience in food and nutrition security issues;
vii. One (1) Social Science Expert with expertise in Fisheries Extension; and
viii. One (1) Communications and Media Expert.

4.3. The team should have proven experience in project management and working with a range of stakeholders, including governmental and non-governmental organizations. Knowledge of climate change issues and disaster risk management in the fisheries sector is required.

4.4. It is expected that the experts in Fisheries and Marine Ecosystem Assessment, Natural Resource Economics, Climate Change and Database Design and Development would each either have a Ph.D. and at least five years proven practical experience in the respective fields, or a Master's Degree with at least 10 years proven practical experience in the respective fields. The experts in Fisheries Management, Value Chain Management Social Science and Communications and Media are expected to have at least a Master's Degree with at least five years proven practical experience in the respective fields. The Social Science expert is also required to have experience working with the fishing sector in small-island developing states.

5. **Place(s) of Work and Coordination**

5.1. The consultant is expected to operate from its own place of work, as well as, St. Vincent and the Grenadines where the regional and training workshops will be convened and the fisheries and environment database would be housed. The consultant is expected to plan and conduct travel missions to facilitate research, training, workshop and consultation activities.

6. **Reporting Requirements and Time Schedule for Deliverables**
a. The following reports/deliverables are anticipated:

i. **First deliverable:** Inception Report; a report including the work plan for the consultancy.
ii. **Second deliverable:** Research planning and implementation outputs for work package 1 – (i) Report of regional planning workshop, and (ii) reports of research investigations of fishery-related ecological and socio-economic impacts of climate change and variability (3 reports, one for each marine ecosystem).
iii. **Third deliverable:** Outputs for work package 2 – (i) Reports of analytical tools and methods developed and applied for incorporating climate change and climate variability data and information into fisheries and marine ecosystem analyses that also incorporate value-chain considerations, including updated advice to inform climate smart fisheries management practices (3 reports, one for each marine ecosystem, including

copies of all inputs and outputs (models, spread sheets etc.)); (ii) regional Fisheries and Environment Database with all project inputs and outputs uploaded as well as meta-database, together with supporting database manual; (iii) reports of regional training workshops on fisheries and marine ecosystem analyses and assessments and use of the regional fisheries and environment database.
iv. **Fourth deliverable:** Outputs for work package 3 – (i) Stakeholder engagement and communication strategy and action plan; (ii) stakeholder engagement materials (six brochures, two PowerPoint presentations, one video-documentary, multi-media library); (iii) report of stakeholder strategy and action plan implementation including consultation reports, and including feasible stakeholder-driven recommendations for climate-smart fisheries management decision-making in the fisheries sector; (iv) report of pre-project survey of Caribbean Fisheries Forum and Ministerial Council to ascertain present status of the knowledge, attitudes and practices concerning fishery-related impacts of climate change and variability and best practices in disaster risk management in the fisheries sector; (v) **i**mpact assessment tool.
v. **Fifth deliverable:** Outputs for work package 4 - (i) Updated Regional Strategy and Action Plan for Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture, and (ii) Final Technical Report.

b. Every report, including manuals, data and information policy and stakeholder engagement materials, must be shared with the CRFM Secretariat for review and inputs prior to finalization. The final versions must be submitted to the CRFM Secretariat in three hard copies and an electronic copy (NB. Zip files will not be accepted). A copy must also be delivered electronically to the MORI Project Management Unit as one electronic file. One copy of the Fisheries and Environment Database and the Multi-media Library must be submitted electronically, in accordance with the regionally agreed data and information policy, using an appropriate mode of transfer.

c. Reports must be submitted on or before the dates agreed during contract negotiation.

d. Reports must be submitted to MORI and simultaneously to the CRFM Secretariat as follows:

► For submission to MORI-
Email to the Administrative Assistant at maxine.ruddocksmall@uwimona.edu.jm
Submit hardcopies to Administrative Assistant
PPCR Regional Project- MORI
Electronics Building, Department of Physics
University of the West Indies
Mona, Kingston 7

► For submission to CFRM-

Email to the Secretariat at crfmsvg@crfm.int
Submit hardcopies to Deputy Executive Director
CRFM Secretariat
Halifax Street
Kingstown
St Vincent and the Grenadines

ANNEX II: INCEPTION REPORT

1 INTRODUCTION

Marine fisheries are complex, multifaceted endeavors that are deeply interconnected with both the ecological and social systems within which they operate. To manage a given fishery resource effectively, practitioners must account for ecological interactions with other marine species and socio-economic interactions with commercial and subsistence harvesters. For example, the degradation of coral reefs not only impacts fisheries; it also reduces protection from coastal hazards and affects the valued tourism sector. However, even fisheries management systems designed for effective sustainable management of individual resources often lack guidance, tools, or strategies to account for broader influences of environmental change, including climate change and variability (Heenan *et al*., 2015, Gaichas *et al*., 2016). In the Caribbean, fisheries adaptation to climate change and variability is an emerging policy and management topic and work to understand the sector's vulnerability and options to adapt is in its infancy.

The "Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System" project (the project) delivers on the regional track of the Pilot Program on Climate Resilience (PPCR). Executed by the Mona Office for Research and Innovation (MORI) at the University of West Indies at Mona, Jamaica, and with the Caribbean Regional Fisheries Mechanism (CRFM) as the co-implementer and service beneficiary, the **project aims to improve availability and use of information for "climate-smart" planning and management in the fisheries and aquaculture sector in the Caribbean**.

Climate-smart fisheries and aquaculture seeks to sustainably increase the sector's productivity, reduce its vulnerability to climate change and decrease its emissions of greenhouse gases. At the same time, ecosystem approaches to fisheries and aquaculture (EAF/EAA) are core to making progress on climate-smart fisheries (Heenan *et al.*, 2015). Given the vulnerability of the fisheries sector to climate change and variability and the importance of fisheries for national economies, livelihoods and food security, the primary focus of this project will be on climate change adaptation.

Project activities are regional in scope and will also strengthen national PPCR programming. Research activities and stakeholder engagement will centre on the six highly climate-vulnerable nations of the Commonwealth of Dominica, Grenada, Haiti, Jamaica, Saint Lucia, and Saint Vincent and the Grenadines (SVG). Dominica was heavily affected by the 2017 hurricane season. Inclusion of stakeholders from that country in project activities and travel for research / engagement missions could present challenges, but should nevertheless be pursued to the extent possible.

On January 24, 2018, the University of West Indies signed a contract with ESSA Technologies Ltd. (ESSA) to undertake the project and meet the following six objectives by February 2020:

Objective 1:	Assess the ecological and socio-economic impacts of climate change and variability on the fisheries resources and sector
Objective 2:	Develop tools and methods for fisheries and marine ecosystem analyses and assessments to quantify the current and future impacts of climate change and variability on fisheries production, post-harvest and marketing systems and associated livelihoods
Objective 3:	Train regional experts in the use of the tools and methods developed to conduct fisheries and marine ecosystem analyses and assessments
Objective 4:	Develop a fisheries and environment database and supporting guidance (associated meta-database, user manual, recommendations on software and equipment)
Objective 5:	Train regional experts in the management and use of the fisheries and environment database
Objective 6:	Build stakeholder awareness on the impacts of climate change and variability on the fisheries resources and sector

Objective 7:	Engage stakeholders in identifying feasible recommendations for climate-smart fisheries management and decision-making.

The project has four inter-related components, or "Work Packages", summarized in Figure 1.

- Work Package 1: Planning and Research Investigations
- Work Package 2: Developing a Climate-Smart Fisheries Monitoring System
- Work Package 3: Facilitating Stakeholder Access and Contribution to the Information Base for Climate Change Adaptation and Disaster Risk Management in Fisheries
- Work Package 4: Facilitating the Integration of Climate Risk and Resilience into Regional Fisheries Development and Planning

Further information on linkages across Work Packages and related activities appears in Section 3.

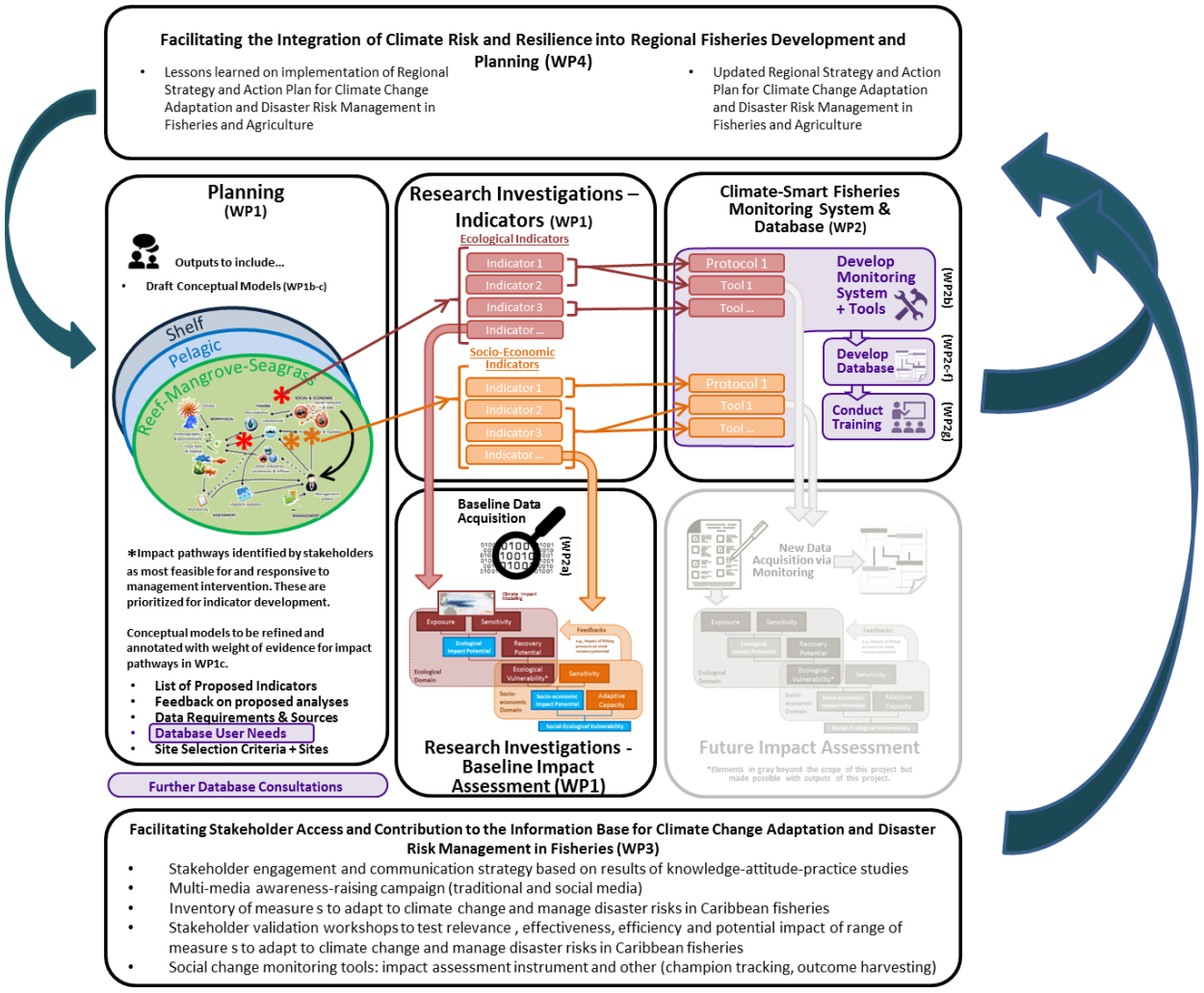

Figure 1: Schematic representation of the project Work Packages and their relationships

This report clarifies the objectives, scope of and progress on project activities; it also details implementation plans and project governance. The structure of the report is as follows. In Section 2 we present a brief summary of literature on climate change impacts on the Caribbean fisheries sector. Section 3 states the objectives of each Work Package, as well as refinements in scope, methods selection and project activities since the project launch, highlighting the most significant changes in understanding of the project context. Work Package 1 will entail the most level of effort and project resources and its implementation will take

place over year 1. Therefore, Section 3 focuses on this Work Package. In Section 4 we provide an updated schedule of project tasks and activities and indicate timelines for outputs and deliverables. Section 5 summarizes the structure of the Project Team and ways in which we will work together. Section 6 summarizes principal risks to the successful attainment of project objectives. Finally, Section 7 includes the next steps that we will pursue in the near term to advance implementation.

2. CLIMATE CHANGE AND CARIBBEAN FISHERIES

2.1 Fisheries and Marine Resources

Globally, fisheries play a crucial role in advancing food security objectives, providing more than 2.6 billion people with at least 20 percent of their average per capita animal protein intake as well as income necessary to purchase food. In the Caribbean region, fisheries activities are critical to human well-being as they provide food and livelihood opportunities for thousands of coastal inhabitants as well as a source of foreign exchange. Fisheries employ nearly 200,000 people in the Caribbean Community, earning USD $5 billion to $6 billion per year in foreign exchange and providing about 10 per cent of the region's protein intake (Nurse, 2011).

Caribbean fisheries and marine resources supply essential goods and services but the health of ecosystems from which these goods and services flow is at risk. Caribbean coral reefs generate between USD$3.1 and 4.6 billion annually from fisheries, tourism and shoreline protection (Burke & Maidens, 2004; Burke & Kushner, 2011). However, coral reefs' coverage across the region are in decline; the region has lost more than 50% of its coral reefs since the 1970s (Mumbly *et al.*, 2014, Jackson *et al.*, 2014). The destruction of coral reefs and other related ecosystems such as seagrass beds and mangroves in the region pose great challenges for coastal livelihoods, food security and the conservation of marine biodiversity.

The region also faces challenges related to fisheries overexploitation, including illegal unreported and unregulated (IUU) fishing, pollution of coastal waters, invasive species, habitat destruction, and coastal erosion. The FAO (2016a) estimates that approximately 55 percent of the commercially-harvested fisheries stocks in the region are already overexploited or depleted and some 40 percent of the stocks are fully exploited (FAO, 2016a). Reef fisheries (e.g., snapper, grouper, lobster, conch), which support the majority of livelihoods in Caribbean fisheries have been particularly badly affected. In addition, IUU fishing is estimated at between 20 and 30 percent of total reported production levels (FAO, 2016a). For the Wider Caribbean region fish production is currently around 1.4 million tonnes, 300 thousand tonnes below the 30-year average (FAO, 2016a).

Since fisheries contribute significantly to coastal livelihoods, food security, local and regional economies in the Caribbean it stands to reason that depletion of fisheries and degradation of marine ecosystems have cascading and adverse socio-economic impacts. Improving the management of fisheries and coral reefs is critically important for the economic, social and environmental future of the Caribbean region (Knowlton & Jackson, 2008).

A changing climate adds to the challenge of sustainably managing the fisheries and aquaculture sector in the Caribbean.

2.2 Climate Change Challenges and Responses

Concern over the consequences of climate change for fisheries production and the state of marine ecosystems is mounting (Brander, 2010; Cheung *et al*., 2010; Mora *et al*., 2013). The increasing frequency and/or intensity of extreme climatic events can affect fish habitat, productivity or distribution, as well as have direct impacts on fishing operations and the physical infrastructure of coastal communities (FAO, 2013). Small changes in environmental conditions, such as temperature, salinity, wind and ocean currents, can alter the abundance, distribution and availability of fish populations (McIlgorm *et al*., 2010). Fishing communities in the wider Caribbean are expected to be severely impacted by climate change as threats to

exposure and sensitivity are high while adaptive capacity is low (Nurse *et al*., 2011). Many fisheries-dependent communities already live a precarious and vulnerable existence because of poverty, lack of social services and essential infrastructure (FAO, 2015).

Shifts in climate variability are also a concern although precise impacts or interactions with climate change are uncertain. The implications of shifts in El Niño patterns on regional marine systems, for example, are poorly understood. El Niño conditions arise every 3-5 years, providing inter-annual regional climate anomalies that profoundly shape marine environments. During El Niño years, the sea surface temperature (SST) in the Caribbean decreases relative to the east Pacific SST. This difference in SST between the two ocean basins sets up a change in atmospheric circulation that favors stronger, low-level trade winds that blow from east to west. Ocean currents respond to this more westward flowing current. In addition, stronger surface winds enhance upwelling and chlorophyll concentrations. The El Niño circulation pattern is consistent with a SST gradient between the east Pacific and the Caribbean. Future projections of SST suggest that the Caribbean will warm by more than 2˚C by the end of the century (Nurse and Charlery, 2014). It is uncertain how the low-level circulation will respond to the projected Caribbean warming.

Table 1 summarizes examples of observed and expected impacts of climate change in the Caribbean marine environment.

Probability of impact	Impact
Already happened / happening	• Rising mean sea levels at rates similar to the global average, with regional differences in inter-annual variability • Shifts in patterns of Atlantic tropical storms, with conflicting evidence of an increase in hurricane intensity or frequency • Warming of Caribbean sea-surface temperatures (SSTs) by approximately 1.5°C over the last century • Mass coral bleaching events linked to extremely high SSTs increasingly documented • Sargassum blooms linked to increased SSTs and other non-climate stressors becoming more common in the past decade • Increasing acidity in the Caribbean basin, with seasonal and spatial variations
Expected	• Rise in average sea levels in the Caribbean and Atlantic greater than the global mean • Rise in SSTs, with spatial variation where northern and northwestern Caribbean are least affected • Continued ocean acidification • Enhanced hurricane and storm intensity • Increased shoreline erosion • Widespread changes in the location, numbers and quality of plants and animals (e.g.,): o Permanent and seasonal movement of marine fishery resources o Changes in species' community structure o Reduced productivity of most marine organisms and ecosystems o Reduced fish size o Reduced coral reef health and effectiveness in attenuating wave action o Collapse of the Mesoamerican barrier reef system by mid-century o Increased incidence of marine diseases o Shoreward retreat of mangroves, where topography and development allow o Drowning of seagrass beds o Increased production of the neurotoxin ciguatoxin

Table 1: Examples of physical and ecological impacts of a changing climate in the Caribbean marine environment (Source: Monnereau and Oxenford, 2017)

Caribbean coastal communities and the ecosystem services they depend upon are at the frontline of some of the most serious threats from environmental change. The region is considered to be one of the most vulnerable regions in the world to the impacts of climate change with coastal communities and low-lying areas being particularly exposed to the combined threats of sea level rise (SLR) and extreme weather events (Nurse *et al*., 2014). The economic cost of adapting to SLR have been estimated to be between US$26 and 61 billion in capital costs and US$4 and 6 billion in annual costs by 2050, increasing rapidly thereafter (Simpson *et al*., 2010). The magnitude of these costs will depend largely on the health of the region's coastal ecosystems, which in many cases are the only coastal defence. Healthy coral reefs can provide highly effective coastal protection, dissipating over 80% of wave energy, producing sand to replenish protective beaches and dunes, and able to grow vertically at the same rate as SLR (Ferrario *et al*., 2014).

Weak management and governance structures, habitat loss and new threats from climate change and ocean acidification contribute to coral reef and fish stock decline in the region (Sary *et al*., 1997; Haughton, 2000; ICRI, 2008; Jackson *et al*., 2014; McIlgorn *et al*., 2010; CRFM *et al*. 2017). Interventions that slow down or reverse the loss of coral reefs are increasingly recognised by CARICOM and the Caribbean Community Climate Change Centre as priorities for adaptation to climate change.

An approach for managing coastal resources on small tropical islands that is emerging as a practical and beneficial strategy is the creation of networks of marine protected areas (McLeod *et al*., 2009; Graham *et al*., 2008; Keller *et al*., 2008). Small Island Developing States (SIDS) worldwide are turning to Locally-Managed Marine Areas (LMMAs) that secure greater local ownership, encourage compliance and support livelihood diversification, as a key approach to marine policy. These advances in marine policy can also benefit from new technologies for spatial planning, enforcement, monitoring and communications that not only reduce management costs but also engage a wider circle of stakeholders with a vested interest in the future of reefs. There are over 250 MPAs in the Caribbean, but only a minority of those have been effective at restoring coastal ecosystems. Effective MPAs tend to be those established with policies that encourage local communities to benefit from the resulting improvements in fishery and tourism revenues (Olds *et al*., 2014; Keller et al., 2008; McLeod et al., 2009 & Mumby *et al*., 2007). In all cases, community involvement was central to their success, and economic diversification a key driver of local support. Not surprisingly, a recent review by FAO (Weigel *et al*., 2014) found that policies that provide incentives for communities to support and engage with the management of MPAs and fisheries generally produce much better results.

Fishing is one of the most energy-intensive food production activities in the world today, as it is highly dependent on fossil fuels and other forms of energy. In the last decade or so, the upward trend in fuel costs has resulted in adverse impacts on fisheries production across the Caribbean (FAO, 2015). The small-scale subsector, which accounts for nearly half of the world's fish production and is particularly sensitive to these changes. Fuel costs, availability and greenhouse gas emissions all influence consumer prices and net incomes of Caribbean producers and processors. Most fisheries rely heavily on fossil fuels for energy, although some examples exist where renewable energy is being exploited (e.g., sails in the artisanal fishery, solar in the industrial). Transportation to and from fishing grounds is the primary consumer of energy, whilst fish processing (e.g., washing and packaging) and storage (e.g., freezers, refrigeration or ice while in transport) also represent significant proportions of the industry's total energy consumption. Efforts are underway to promote the use of renewable energy by fish processing plants (Singh-Renton, pers.comm.)

3. UPDATED SCOPE AND METHODS

Between January 17th and February 22nd, the Project Team undertook three types of inception activities that served three main purposes: understanding the service recipient's – CRFM's—needs and expectations for the project, as well as extent of support to be provided; advancing scoping decisions; and cultivating trust among members of the Project Team. The inception activities comprised two virtual meetings and follow-up email correspondence with the CRFM client; at least nine virtual meetings with different configurations of the Project Team; and a review of literature and online publications and databases. These meetings and the insights gleaned from reviewing easily-accessible information fed into the following scoping considerations for the four project Work Packages.

Initial discussions with the CFRM client helped clarify measures of project success. These are as follows:

- A project process that includes high level of meaningful consultation with stakeholders from the 6 PPCR countries
- Increased information available on climate change impacts on fisheries and resilience options
- Increased understanding by technical, policy and industry / fisher folk of climate change impacts on fisheries and resilience options
- Project outputs that are nationally-relevant / applicable, with potential for regional aggregation
- A high potential for sustainability of results in the absence of CRFM support

It's worth clarifying that the sub-sections that follow do not repeat the contents of ESSA's Technical Proposal. The approach, phases and tasks outlined in it remain valid, although the ordering (and therefore numbering) of tasks has been modified in selected cases. The sub-sections below provide new information on the scope, methods, sequencing and timing of activities.

3.1 Work Package 1 – Planning

Objective 1:	Assess the ecological and socio-economic impacts of impacts of climate change and variability on the fisheries resources and sector
Objective 2:	Develop tools and methods for fisheries and marine ecosystem analyses and assessments to quantify the current and future impacts of climate change and variability on fisheries production, post-harvest and marketing systems and associated livelihoods
Objective 5:	Build stakeholder awareness on the impacts of climate change and variability on the fisheries resources and sector

Work Package 1 (WP1) comprises four phases, the first of which is Phase I Project Initiation. Aside from tasks related to the inception activities described above, this phase of the project includes the delivery of a Regional Planning Workshop as a major task. Successful delivery of this workshop will contribute to achieving project objectives 1, 2 and 5.

Task 1: Inception Activities:
Completed.

Task 2: Regional Planning Workshop
Initial discussions regarding joint workshop planning with the Client Task Team have been underway since the project launch. Contingent on confirmation from the PPCR Procurement Office at MONA of funding available to subsidize participants' attendance, the workshop would take place in Kingstown, SVG, on April 25 and 26, 2018. Participants would include one to two senior technical specialists from each of the six PPCR target countries in the Caribbean (Commonwealth of Dominica, Grenada, Haiti, Jamaica, Saint Lucia and St. Vincent and the Grenadines), two CRFM representatives and members of the ESSA Project Team.

The anticipated objectives of this workshop are multi-faceted and listed below. **Establishing a project committee with representatives from the six PPCR countries will be one of the outcomes of the Regional Planning Workshop** (or soon after). Representatives on this committee can help guide progress of project outputs, help us gain access to contacts in each country and can be the on the ground presence to help with follow up in each of the countries:

1. to develop a shared and common understanding of the ecological and socio-economic components of the fisheries system at regional / national scales (by eliciting feedback on draft conceptual models),
2. to clarify the decision-relevant focus for a climate-smart fisheries monitoring system (which kinds of activities are feasible),
3. to identify elements of the fisheries and environment database that will be used to support this monitoring system,
4. to discuss criteria for selection of pilot study sites and candidate site suggestions for the eventual implementation of the monitoring system, and,
5. to establish a baseline of knowledge, awareness and practice on climate adaptation and disaster risk reduction responses within the fisheries sector.

Discussions at the Regional Planning Workshop will help scope and refine elements of WP1, WP2 and WP3. Moreover, the Regional Planning Workshop will be the only opportunity for the ESSA sub-team working on the ecological impact assessment of WP1 to get direct feedback from technical specialists in the six PPCR countries. We are currently developing the agenda for the Regional Planning Workshop, which will involve facilitated discussions and structured exercises that will help elicit information from participants related to each of the proposed objectives. The Regional Planning Workshop will involve a smaller and less diverse group than we had initially anticipated in developing the technical proposal. Therefore, to supplement the feedback provided in the face to face meeting we will host a 1.5-hour webinar post-workshop with a longer list of regional and national experts to confirm the accuracy and completeness of workshop outputs.

In the lead up to the Regional Planning Workshop we will undertake several preparatory activities, which we describe in sections 3.2., 3.3., 3.4. and 3.5. The ESSA project manager will work with Client Task team to reach out to PPCR nations to recruit workshop delegates and distribute seeding documents in time (two weeks prior) for participants to review and come to the workshop prepared to engage in the discussions.
The workshop report will roughly follow this draft outline.

- **Executive summary**
- **Purpose and overview of the workshop process**
- **Climate change impact pathways in Caribbean fisheries**

(Revised conceptual models of the climate-sensitive components of the fisheries system for each of the three target ecosystems – mangrove-reef, pelagic, shelf, including stakeholder feedback from the workshop. This includes value chain considerations.)

- **Purpose of a climate-smart fisheries monitoring system**

(Clarify whether the greatest added value is in improving status and trend monitoring or management effectiveness monitoring, for example.)

- **Tools and databases with potential to improve climate-smart management and policy decisions**

(Policy and management decisions in most need of climate and vulnerability information. Summary of analysis, assessment, modelling and database tools with most potential to be useful. Summary of user needs & training requirements, data requirements, and potential data sources.)

- **Preferred implementation options and integration with existing monitoring systems**

(Analysis of issues that currently prevent data sharing and effective use of data for sustainable fisheries management. Implementation options that take into account barriers to uptake and long-term use. Summary of the discussion on pilot site selection.)

- **The role of project communications**

(Baseline of knowledge, attitudes and practice toward climate-smart fisheries and proposed communications objectives for the project.)

- **Terms of reference of the project committee**

3.2 Work Package 1 – Research Investigations

Objective 1:	Assess the ecological and socio-economic impacts of impacts of climate change and variability on the fisheries resources and sector
Objective 2:	Develop tools and methods for fisheries and marine ecosystem analyses and assessments to quantify the current and future impacts of climate change and variability on fisheries production, post-harvest and marketing systems and associated livelihoods

This section focuses on progress in scoping and planning of Phase II (Scoping and Qualitative Research), Phase III (Impact and Vulnerability Assessment) and Phase IV (Reporting) of WP1. Successful delivery of tasks and activities throughout these phases will contribute to achieving project objectives 1 and 2.

Phase II: Scoping and Qualitative Research

TASK 1: Assembly of Available Climate, Environmental, Fisheries and Socio-Economic Data

This task involves independent research as well as working with local scientists and managers to acquire ecological, habitat, fisheries and socio-economic data identified as being important to decision-making, with a view to populating indicators and undertaking impact assessment studies. The first part of this data assembly task is well underway, with numerous relevant resources and data sets identified through preliminary online searches and literature review. The second part of this data assembly task is to identify and reach out to key data holders to determine what data are available, what people are willing to share, at what resolution and timescales and what steps need to be taken to acquire the data.

This process has been initiated with support from the Client Task Team, and will be ongoing following the identification of and consultation with **key fisheries and environmental management delegates in each PPCR country** to determine further information needs and availability going forward.
The results of this initial sweep are summarized below:

Climate Data

- Our team has been working with the CRFM Secretariat and its contacts in the region to investigate the availability of downscaled regional climate models, particularly Coupled Atmospheric-Ocean Global Climate Models (AOGCM).
- Global products are definitely available at resolutions of down to around 1° (e.g. from the CMIP5 database https://portal.enes.org/data/data-metadata-service/search-and- download/cmip5-access) which have been interpolated to a 0.5° spatial grid by team members based at the University of British Columbia, with particular attention paid to coastal environments.
- However, per Dr. Cédric J. Van Meerbeeck at the Caribbean Institute for Meteorology and Hydrology, there are no regionally downscaled regional or global model outputs at <0.5 degree resolution that include biogeochemistry (which is required for the full modelling approach).
- Thus, modelling will be carried out using 3 available CMIP-5 climate models (Institut Pierre Simon Laplace, Geophysical Fluid Dynamic Laboratory and Max Planck institute products). Analysis is still possible at this coarser scale, but will require additional steps in terms of development and application to make outputs relevant and will have implications for the resolution of the results, particularly for the smaller PPCR nations, which we describe more fully in Phase III: Impact and vulnerability Assessment.
- Important regional experts to follow up with on climate data include:
    - **Dr. Cédric J. Van Meerbeeck** at The Caribbean Institute for Meteorology and Hydrology [mailto:cmeerbeeck@cimh.edu.bb] [website] (regional climate modelling expertise)

- **Dr. Michael Alexander Taylor**, MONA Faculty of Science & Technology, [michael.taylor@uwimona.edu.jm] [website] (coauthor on several recent regional climate modelling papers, regional expertise in climate models and databases)
- **Dr. Mark Eakin**, NOAA Satellite Oceanography & Climatology Division, Marine Ecosystems & Climate Branch, [mark.eakin@noaa.gov] [website] (coral reef specialist and author of the degree heating week index as a coral bleaching index)

Ecological Data:

Our team has also begun to compile lists of existing regional environmental data and monitoring programs that could be used to inform quantitative regional-scale modelling or the qualitative national-scale inferences that can be made from the models in combination with these local datasets. They will also serve as a general resource to inform baseline data and future impact assessments. These include:

Lists of key species in each pilot country to be included in ecological impact assessment modelling.

- Initial lists will be compiled for each country to include dominant commercial fisheries species (as measured by total catch) (see Appendix 1).
- However, these lists will also seek to include species of subsistence or cultural importance as well as keystone ecological species supporting key ecosystems regardless of their commercial value.
- Initial lists will be *iteratively revised* with input from the CRFM and regional stakeholders at the Regional Planning Workshop, and we will seek to include all species represented on these lists in our broader regional assessment modelling.

Species-level biological information for key fisheries species to feed the modelling exercise, such as species life history traits, and habitat dependencies.

- Occurrence data will be populated from the Ocean Biogeographic Information System (OBIS – www.iobis.org); Intergovernmental Oceanographic Commission of UNESCO (IOC- www.ioc-unesco.org/); the Global Biodiversity Information Facility (GBIF – www.gbif.org), FishBase (www.fishbase.org) and the International Union for the Conservation of Nature (IUCN – http://www.iucnredlist.org/technical-documents/spatial-data).
- All traits or physiological information including habitat dependencies will be gathered from FishBase, the published and grey literature, as well as from the outputs of the study performed by Jones & Cheung (2005), and updated with regionally-relevant data where available.

Habitat distribution information for key habitats being assessed including coral reefs, mangroves, seagrasses, pelagic ecosystems, and shelf ecosystems.

- Distribution maps of varying accuracy of different biogenic habitat types (Landsat imagery acquired in the late 90s early 2000s) are available as shapefiles through the UNEP & WCMC Ocean Data Viewer for seagrasses, mangroves, and coral reefs. These will be updated to reflect possible changes in habitat quality and extent based on local studies, where available and feasible according to the modelling procedure.
- Similar and more recent habitat distribution data layers, including layers of the extent of shelf habitat, are also available from CaribNode.
- High-resolution (4 km) distribution maps of coral reef bleaching vulnerability for the Caribbean region (Hooidonk *et al*., 2015).
- Comprehensive review of threats to Caribbean coral reefs from the World Resources Institute Reefs at Risk in the Caribbean report, which includes links to anthropogenic drivers. Although not used in modelling, we can use this information for qualitative regional vulnerability descriptions.

We expect the last two resources in particular to be primarily used to inform the country-level conclusions, which we draw from the regional modelling exercise.

Habitat status and biodiversity information for key habitats being assessed including coral reefs, mangroves, seagrasses, pelagic ecosystems, and shelf ecosystems. Because many of these data sets will vary in spatial scale and data quality, they are not suitable as inputs for quantitative modelling. Instead, the local-scale information referenced here will be used in conjunction with the regional model outputs to inform country-level implications of climate change for different ecosystems and their associated species as well as likely impacts on the livelihoods that depend upon them (drawn from socio-economic analysis described in Phase III – TASK 2: Quantitative Assessment of Socio-Economic Impacts on Caribbean Fisheries).

- Site-level habitat status information is available from the Regional Reef Assessment and summarized in a series of national and site-level report cards available for all pilot countries in the Eastern Caribbean including the recent addition (2017) of report cards for Jamaica and Haiti in the Greater Antilles.
- Site-scale raw data from underwater visual census surveys across the Caribbean region from the AGRRA (Atlantic and Gulf Rapid Reef Assessment) Monitoring Program database, including coral reef condition and % cover, reef fish biomass and biodiversity.
- Additional monitoring data is likely to be available through the UWI Centre for Marine Sciences – Caribbean Coastal Data Centre.
- Reef monitoring data for Haiti may be available via historical ReefCheck documentation and through a recent ReefCheck Haiti project, as well as from the main local eNGO, the Fondation pour la Protection de la Biodiversite Marine (FoProBiM) [Contact: **Jean W. Wiener**, Director, jeanw@foprobim.org]. Henri Vallès (hevals@hotmail.com), currently working at CERMES Cave Hill Campus in Barbados, and who was previously stationed in Haiti may also have useful information and contacts.
- We will also investigate habitat data from the Mapping Ocean Wealth project's Atlas of Ocean Wealth, which contains global modelled map layers of:
    - coastal protection offered by coral reefs and mangroves
    - visitation value of coral reefs for tourism
    - blue carbon sequestration potential of seagrasses and mangroves

Fisheries Data:

- Given the variability in the accessibility and quality of fine-scale catch data from Caribbean PPCR countries, we will plan to use the national reconstructed fisheries catch estimates drawn from the Sea Around Us project catch database. Using this source of catch data offers numerous advantages: it includes estimates of subsistence and unreported catch not available in national monitoring data, it has been derived using a standardized methodology across all countries, and this catch database is regularly maintained and updated and will be for the foreseeable future.
- We will also investigate additional habitat-specific data from the Mapping Ocean Wealth project's Atlas of Ocean Wealth, which contains global modelled map layers of:
    - fish catch from coral reefs (via expert elicitation supported by local data and studies)
    - fish catch from mangroves (via expert elicitation supported by local data and studies)
    - Comparative but qualitative data on fisheries activities in Caribbean seagrass habitats is available from a study by Nordlund *et al*., 2017.
- CRFM does not have a consolidated fisheries database. The regional body makes requests to each country for fisheries data whenever they undertake assessments. Fisheries data holdings differ across the region. Some countries have better coverage for particular species. In the case of Jamaica, for example, conch data are comprehensive compared to data for other species. Landings data by species and by year will be available for all 6 PPCR countries. Fishing effort is not typically well recorded but may be available for fisheries that are more actively managed (Singh-Renton, pers.comm.).
- Where possible, we will attempt to incorporate local catch records that have greater detail and reliability than catch reconstructions into our analysis, especially for the most important fisheries species in each pilot country, which are more likely to be closely monitored. We intend to make inquiries regarding local catch data through the fisheries representatives nominated by each target country to represent them in this project.

Socio-Economic Data:

The assessment of socio-economic impacts on Caribbean fisheries will involve primary data collection via interviews, surveys and focus groups in 2 to 3 pilot sites in the 6 PPCR countries. Secondary data and data from online and official databases are also very important in the absence of sufficient primary information and limited time in the field. Compared to the case with climate and ecological data, the sweep for socio-economic data is not as advanced. Nevertheless, we have identified a range of data types that will be necessary for socio-economic/value chain assessment as well as a few data sources.

- Census data on demographics and data to develop community profiles will be necessary. We are looking at the findings of CRFM's Diagnostic Study to Determine Poverty Levels in CARICOM Fisheries Communities.
- Data on livelihood dependency, seafood contribution to household income, rate of return on investments, access to inputs and services (such as fuel subsidies, duty free outboard engines), formal and informal access to capital, insolvency and debt issues, and access to other safety nets to assess community resilience. We are looking through databases from other regional projects with socio-economic outputs, such as the Global Socio-economic Monitoring Initiative (SocMon) and the Caribbean Fish Partnership Project (C-Fish Project). We are also reviewing the CRFM-sponsored study "Costs of Impacts of rising cost factors in fishing operations in the CRFM Member States". The Project Team is exploring reliable sources of cost and earnings data per fleet or species/stocks.
- Fisheries economics data (including fuel subsidies, research and management investments, and other input and services to the fishing sector) are also published in peer reviewed journal articles, such as Khan *et al*., 2006 and Schuhbauer, 2017.
- We can obtain fisheries market and trade data from Globefish and Infopesca.
- We may seek supplementary information about number and types of vessels, fishing port infrastructure (e.g., wooden vs. concrete piers, etc.), and other aspects of the built environment at pilot site locations from global/regional spatial databases, particularly if sites are difficult to access.
- To inform assessment of expected climate exposure of fisheries infrastructure and fishing communities to direct climate impacts (e.g., through storm activities, ocean acidification, and loss of revenue) we will draw from loss and damage data in published reports (e.g., GIZ, 2015), post-disaster needs assessments and other disaster risk reduction studies. This includes regional and country case studies on loss and damage from the Economic Commission of Latin America and the Caribbean as well as post-disaster needs assessments (PDNA) developed by individual nations, such as the PDNA for Dominica resulting from the 2017 hurricane season.
- To measure flow-on impacts resulting from changes in expenditure or income due to climate-related events and perform standard multiplier analysis we will use input-output (I-O) tables or Supply-Use tables that already exist for specific country applications (e.g., the IDB study for Jamaica). In the absence of I-O tables for specific country applications, we will follow the procedure described in Southwick et al (2016) for transferring multipliers across jurisdictions.

In sum, preliminary data and information gathering is complete for the ecological component of impact assessment and incipient for the socio-economic components. Additional information gathering will continue throughout the remainder of the ecological and socio-economic impact assessment. We will develop a compendium of climate, ecological, fisheries and socio-economic datasets that we use in our baseline impact assessment, which we will store in a project database, for access by CRFM States.

TASK 2: Criteria for Pilot Site Selection

The Terms of Reference for this project calls for the identification of pilot study areas within the six PPCR countries for the eventual implementation of the monitoring system. The focus on pilot study areas provides a useful bounding for activities in WP1 and WP3 as well. We propose layering project activities across a consistent set of pilot study areas as opposed to dispersing project activities across a wider range of pilot study areas to maximize geographic coverage. The first option provides efficiencies, continuity, and greater

potential to usefully integrate project components and promote sustainability of project results. In comparison, the second option has the potential to spread engagement and project benefits more widely but would limit the ability to leverage lessons from the work across Work Packages, potentially diminishing the relevance of project outputs.

In the context of WP1, socio-economic impact assessment work will include a limited amount of primary data collection to understand the adaptive capacity of the fisheries sector. Selecting pilot study areas, therefore, is an important step that will inform subsequent project activities (data collection and analysis). **Based on Project Team discussions (internal and with the CRFM Client) to date and budgetary considerations, we propose to undertake localized project activities at up to three pilot sites.**

In selecting pilot project sites "country make up" is a first consideration. SVG, Saint Lucia, Dominica and Grenada are in the Lesser Antilles/Eastern Caribbean and are a part of the Organization of Eastern Caribbean States (OECS). These countries share a number of similarities that can be attributed to their geographic proximity, and socio-political, historical and linguistic background. As a larger island, located in the Western Caribbean Jamaica has a different profile, but it shares some of the socio-political, historical and linguistic background of the OECS countries. Haiti is the outlier and would require a specific strategy due to language differences (French/Creole) and known deficiencies in official data.

Aside from representativeness in terms of country make-up/background, proposed selection criteria are as follows:

- Representativeness (ecological attributes such as Marine Protected Areas/fish sanctuaries or critical habitats, socio-economic reliance on seafood, biogeographical diversity, differences in governance and institutional strength);
- Strong coupling of ecological and social systems to understand feedbacks and responses (or complete decoupling of systems such as in aquaculture or fish farming);
- Data availability, both high and low;
- Level of stakeholder interest in climate resilience;
- Potential access to a wide range of knowledge holders (fisher folk, fishing cooperatives, fish vendors, fish processors, fisheries officers, policy makers);
- Ability to undertake research / engagement in a way that is socially inclusive.

It is also worth considering the relative priority Caribbean PPCR countries have assigned to the fisheries sector for promotion of adaptation and climate resilience.

Dominica: Agriculture and food security, water quality and quantity, fisheries, climate change impacts on coastal and marine resources, infrastructure and human settlements, tourism, forestry.
Grenada: Integrated water resource management, capacity building at the sector level, and data management.
Haiti: Agriculture and food security, coastal zone management and reconstruction (sectors/themes) are the main areas, with sub-sectors/themes being infrastructure, land planning and data management.
Jamaica: Agriculture, land-use planning, health, water resources, integrated coastal zone management, climate proofing of national and sectoral plans, tourism, and data management.
Saint Lucia: Agriculture, coastal and marine resources, financial sector, forestry, biodiversity, health, human settlement, critical infrastructure, tourism, and water resource management. Data needs were also highlighted for Saint Lucia particularly the need for Bathymetric and Hydrometric data.
Saint Vincent and Grenadines: Monitoring and evaluation of environmental hazards, watershed management, public sensitization and awareness, integrated planning, and data management.
PPCR Country Priorities, as listed in the 2012 Caribbean Regional Strategic Program for Climate Resilience (SPCR)

Table 2: PPCR Country Priorities, as listed in the 2012 Caribbean Regional Strategic Program for Climate Resilience (SPCR)

Based on preliminary review against these criteria, sites of interests include: Montego Bay in Jamaica; Soufriere in St. Lucia; Kingstown in SVG; and Roseau in Dominica. Montego Bay is highly coupled, with MPA and mangrove ecosystem linkages and reliance of seafood for both local consumption and export markets. Sufficient secondary data exist. There is strong stakeholder interest in climate change, not to mention the availability of sea level rise and loss and damage estimates for coastal infrastructure. We note, however, that Montego Bay is currently under a State of Emergency, which will extend to May. The site in St. Lucia shares many of these traits. As for Dominica, our likely Francophone study site, Roseau might be a candidate site, owing to the processing and trade dimensions; there should be a cooperative there and potential livelihood synergies to explore. The key marine ecological reserves, such as Scott's Head, require travel by car. This site however likely lacks the socio-economic profile and volume of landing sites required for the socio-economic impact assessment.

The final selection of pilot study sites will ultimately depend on feedback from the Client Task Team and stakeholders at the Regional Planning Workshop.

TASK 3: Qualitative Pathways of Ecological Effects Analysis

For efforts to incorporate climate change effects into fisheries management to be successful, it's important to first characterize the boundaries of the system and interactions among components. *Conceptual models* provide an intuitive, visual approach for stakeholders to map out links among key components, interactions, and leverage points for management intervention to help establish a common understanding and consider fisheries management issues within their broader context (Gaichas *et al*., 2016). In addition, conceptual models will support the interpretation of modelling results for key species, dependent on each of the habitats for which conceptual models are developed. These conceptual models will be developed to focus on those pathways within the sphere of influence of regional natural resource management agencies, rather than elaborating finer-scale biogeochemical impact pathways driven by global processes.

We propose to develop linked conceptual models, with stakeholder input, for each of the key habitats under consideration and their related fisheries:

- Reef /Mangrove / Seagrass *(may be disaggregated for conceptual modelling)*
- Pelagic

It remains to be determined whether shelf habitat will be included, as it is not yet clear whether there are significant shelf fisheries in the pilot countries being assessed.

Sub-Task 3.1: Preliminary Conceptual Models

In Sub-Task 1 of this phase, we plan to build rudimentary conceptual models for each of these habitats based on preliminary literature review prior to the Regional Planning Workshop. These models will be presented at the workshop for stakeholder validation and additional input, with a focus on eliciting and capturing (1) the local contexts of these habitats and their fisheries and (2) what points of intervention and management tools are most feasible for each PPCR country. The revised conceptual models will then be built out further in Sub-Task 2 through additional literature review to determine the current state of knowledge and thus weight of evidence for particular fisheries-related stressor pathways and corresponding management interventions.

Sub-Task 3.2: Full Qualitative Pathways of Effect Analysis

Building on the revised conceptual models from Sub-Task 1, we will combine literature research, expert elicitation, and potentially stakeholder surveys to characterize each stressor pathway of effect within each key ecosystem's conceptual model (i.e., anticipated direction, magnitude, potential for management intervention) and assess the weight of evidence (i.e., relative certainty) for that pathway. Figure 2 shows an example of a simple conceptual model pathway of effects analysis completed for eulachon, a beach and

river-spawning fish present on the west coast of Canada, where each numbered pathway (or set of related pathways) is identified and assessed for weight of evidence (Olson *et al*., 2015).

Undertaking this analysis involves setting up a template that takes researchers through a systematic process of summarizing information from secondary sources and evaluating it according to pre-defined criteria. Information captured in templates is then synthesized into a narrative report that describes the weight of evidence for anticipated magnitude, direction, and mechanism of impact of climate-related and other stressors on key ecological aspects of the Caribbean fisheries system as identified by stakeholders.

Although the detailed habitat conceptual models will focus on climate-related stressors, they will also include non-climate-related stressors that may contribute to cumulative effects on habitats which reduce their resilience to climate change (Darling *et al*., 2016). Beyond defining mechanisms of impact, this task will also strive to identify and define weight of evidence for different management actions at specific intervention points along impact pathways. In addition to the benefits of fisheries management for reducing fishing pressure, this aspect of the modelling would demonstrate the importance of non-fisheries management actions for reducing other cumulative stressors and highlight the role of some habitats in helping to attenuate climate change impacts.

These models and supporting evidence will be used to help interpret the results of the quantitative ecological impact assessment and will serve as a starting point for identifying important variables for status and trends monitoring as well as entry points for management intervention that will be developed in later phases of this project, within the context of a climate-smart fisheries monitoring system.

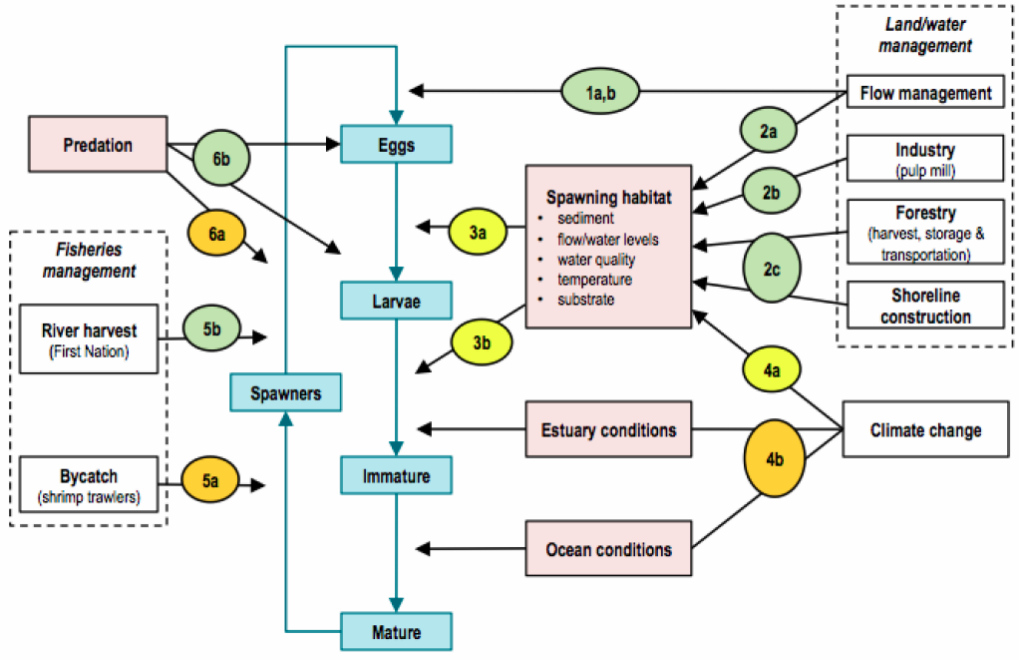

Figure 2: A diagram illustrating a simple conceptual model pathway of effects analysis, where each link in the qualitative conceptual model is assessed through literature review to determine its weight of evidence as a driver of change, and these links can then be colour-coded based on that weight of evidence (e.g., green = high, orange = moderate, yellow = low). Each of these links is identified by a number and letter, which correspond to numbered paragraphs in the reporting narrative describing the weight of evidence for that link. Reproduced from Olson et al., 2015.

Phase III: Impact and Vulnerability Assessment

TASK 1: Quantitative Assessment of Ecological Impacts on Caribbean Fisheries

Introduction

Although climate change complicates the conservation and management of marine biodiversity and fisheries, assessments of the impacts of climate change on marine fisheries frequently focuses on exposure metrics but fail to take into account the intrinsic differences among species that might mediate their response to these drivers (i.e., sensitivity). Recent years have seen an increase in risk and vulnerability assessment studies that consider existing knowledge concerning exposure, sensitivity and adaptive capacity (Jones & Cheung, 2017; Cheung *et al*., 2005; Garcia *et al*., 2014). Such approaches recognize that the risk related to climate change impacts is a function of the magnitude of hazards a species is exposed to, and the biological and ecological attributes that indicate a species intrinsic sensitivity to environmental change and its capacity to adapt and cope with that change i.e., adaptive capacity. The mapping of species' vulnerability to climate change and fishing can be facilitated by using available quantitative vulnerability indices. Specifically, the indices developed by Cheung *et al*. (2005) and Jones and Cheung (2017) use published information on species' ecological and biological traits to estimate vulnerability and risk of impacts to fishing and climate change, respectively, for all exploited fishes globally. These approaches drew on the vulnerability framework used by the Intergovernmental Panel on Climate Change (IPCC) in their Special Report on Extreme Events (IPCC, 2012) and Fifth Assessment Report (IPCC, 2014), and incorporate information pertaining to a species' exposure to hazard, sensitivity, and adaptive capacity.

Adjustment of Ecological Impact Assessment Approach to two Spatial Scales

In carrying out our data-gathering activities during the inception phase, we have surfaced a challenge in data availability that requires revising the scope of our biophysical modelling exercise and adjusting the subsequent outputs from this Work Package. We originally anticipated carrying out the modelling exercise at a high (i.e., sub-national) spatial resolution, but the lack of detailed downscaled regional climate models or available biogeochemical data at the desired resolution (0.1°), requires that we adjust our approach to use coarser global climate models at an interpolated 0.5° resolution. Unless finer-resolution ocean chemistry models are discovered through additional follow-up with regional climate modelling experts, the assumption moving forward is that quantitative ecological modelling will be completed at a regional (i.e., Caribbean basin-wide) scale. The implications for the ecological assessment task are that it will now be divided into two components by level of spatial scale:

- First, we will produce a ***regional-scale quantitative analysis***, deriving ecological community-level indices of impacts (species invasion, extinction and turnover) as well as change in maximum catch potential (MCP) at this basin-wide resolution. The model produces estimates of turnover and yield at the individual species scale, and results will be reported at both the aggregate community scale as well as at the species scale for the most important commercial species included in the analysis, as selected through data review and consultation with regional experts.
- Second, we will produce ***national-scale qualitative assessments***, drawing on our regional modelling results, conceptual models, literature review, and regional expert opinion, to make inferences about the risks of climate change impacts to ecological communities at the national level (described further in Sub-Task 1.3: National-scale Summaries of Ecological Vulnerability).

Sub-Task 1.1: Identifying Key Focal Fisheries Species for Modelling & Preliminary Results

We aim to map the risk of impacts to key species (including key exploited finfishes and invertebrates) to climate change impacts in the ocean based on indices of relative abundance and change in maximum catch potential.

We carried out an initial investigation into the key fisheries species that should be included in modelling by examining catch data extracted from the Sea Around Us Project (SAUP) Global Fisheries Catch Reconstruction database for the entire time series available for each pilot country (1950 – 2014). Catch data

for each individual country was summarized to identify the top 30 species or species groups by total landings across the entire time series, and across all fisheries sectors with reconstructed catch (i.e., industrial, artisanal, subsistence, and recreational) (see Appendix 1) for country-specific lists broken down by landings in each sector). The resulting species lists were merged to create a single draft list of 45 individual species (including both fish and invertebrates) and a further 33 broader taxonomic groups (including some overlap with the individual species) important across all PPCR countries (Table A-1). At a minimum, our ecological impact assessment will model impacts across these 45 key individually-identified species, and we will further consult fisheries representatives from each PPCR country to determine which additional species should be disaggregated from the broader taxonomic groups to add to this analysis (e.g., smaller reef-associated species such as surgeonfish, wrasses, and grunts), and whether any other species should be added in light of high cultural or ecological importance. Although we do not display this information in the appendix, each species and taxonomic group is also associated with landed values and specific gear types in the raw Sea Around Us data, which will be informative for the socio-economic impact assessment.

Sub-Task 1.2: Regional-Scale Quantitative Ecological Vulnerability and Impact Modelling

The regional component of the ecological impact assessment will be carried out through a quantitative modelling exercise that integrates the biological, habitat, and fisheries characteristics of the priority species agreed to by the Project Team and the Client Task Team. The objective of this sub-task is to assess the risk of climate impacts on key species, ecological communities and fisheries in the medium (2050s) and long (2090s) term under alternative climate change scenarios.

Biological and ecological data for the list of identified key species will be incorporated into a modelling framework called Dynamic Bioclimate Envelope Model (DBEM) (Cheung *et al*., 2011; 2016) (Table 3). The DBEM model provides estimates of the risk of particular species and ecosystems to climate change impacts by integrating the ecological *sensitivity* of organisms (based on biological traits and inferred temperature tolerance limits), their *exposure* to climate change (based on expected changes to the local physical environment), and elements of *adaptive capacity* (life histories and capacity for range shifts) (Cheung *et al*., 2011) (Table 3, Figure 3). Exposure, in this context, is determined based on a range of multi-environmental niche model (ENM) ensemble projections of climate change under future climate scenarios. Here, we will focus on two global greenhouse gas (GHG) emission scenarios - Representative Concentration Pathways (RCP) 2.6 and 8.5. RCP 8.5 is a high-emissions scenario where GHG emissions continue with business as usual, and RCP 2.6 is a low-emissions scenario where considerable climate mitigation efforts result in a lower change in radiative forcing by 2100.

Based on DBEM modelling outputs, we will calculate three separate indices representative of the level of climate change impact at the ecological community level: (1) species extinction, (2) species invasion and (3) species turnover. These three indicators represent changes in species composition with ecological theory predicting that such changes in a community will alter trophic structure and thus ecosystem function and associated ecosystem services.

Furthermore, DBEM also allows modelling of projected changes in fisheries catch (expressed as change in Maximum Catch Potential or MCP). Changes in species distribution as a result of climate change, and consequent changes in productivity as well as community and trophic structure will have an effect on fisheries. DBEM integrates changes in primary productivity with changes in species' habitat suitability as a result of climate change, and simulated spatial population dynamics (including movement and dispersal of larvae and adult individuals, population growth, and the ecophysiological effects of changes in temperature, oxygen and pH on growth, body size, mortality and reproduction) (Cheung *et al*., 2013).

Model Inputs	Model Outputs
• A database of underwater environmental data (e.g., typically sea surface temperature, salinity, dissolved oxygen, pH etc.) *(informs habitat suitability for focal species)* • A database for occurrence data for species identified as of interest for this project and associated catch from the Sea Around Us reconstructed catch database (by gear where possible and separated by type of catch (i.e., commercial / industrial vs subsistence if possible) • Metadata on each of the species (trophic level, life history characteristics, etc.) – much of this information can likely be extracted from FishBase and updated with country-specific data / information where and if relevant.	• Habitat suitability index (Ensemble envelope approach using minimum 3 ENM: (1) Maxent, (2) a boosted regression tree & (3) the Non-parametric Probabilistic Niche Model). • Maximum catch potential (MCP) from Dr. Cheung's DBEM model – which is the main indicator that will feed into the socio-economic impact assessment. • Local species extirpations and gains under future climate regimes (so-called local species invasion and extinction indices that are determined based on changes in habitat suitability as a result of climate change). • Relevant indices, including change in catch potential per pixel or per EEZ depending on the most appropriate scale.

Table 3: Environmental input modelling required inputs and anticipated outputs

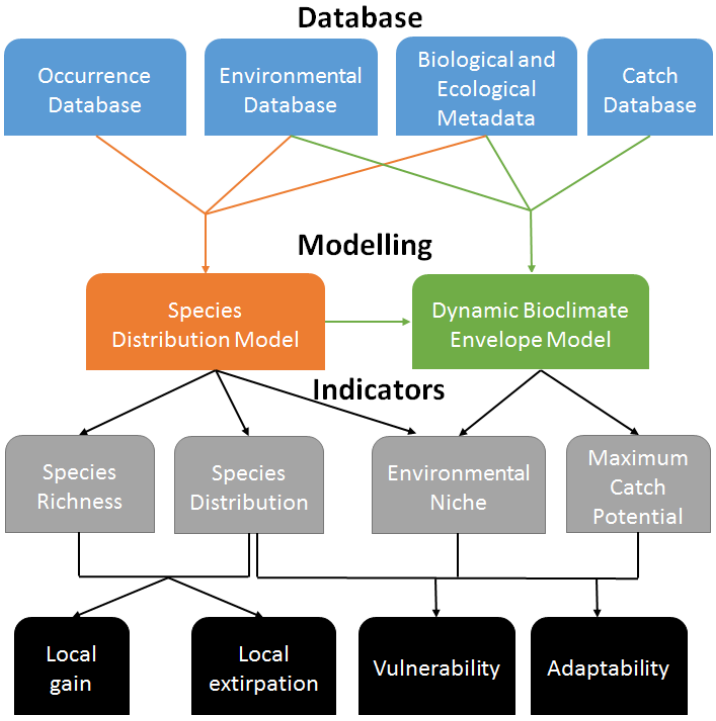

Figure 3: A schematic illustrating the interrelationships between DBEM modelling inputs and outputs shown above.

Sub-Task 1.3: National-scale Summaries of Ecological Vulnerability

The national-scale assessment summaries for each PPCR country will draw on our regional modelling results, conceptual models, literature review, and regional expert opinion, to make inferences about the risks of climate change impacts to ecological communities at the level of each nation. These assessments will leverage many of the additional resources identified during data-gathering in Phase II, which could not be included in models, including:

- site-level monitoring information on habitat quality;

- regulations controlling impacts on key habitats (e.g., no anchoring on seagrass beds);
- legislation on seasonal closures and size restrictions for the harvest of certain species;
- management mechanisms to control other cumulative stressors (e.g., sewage and siltation);
- other factors potentially facilitating adaptation to climate risk at the national scale.

This more holistic qualitative assessment approach will likely be particularly important for smaller and closer-together PPCR countries such as Saint Lucia and Dominica, for which modelling data and outputs at coarser regional scales will be difficult to disentangle. Conversely, data and outputs will likely be resolved enough to provide meaningful quantitative data outputs for larger PPCR countries such as Jamaica and Haiti. The challenges of quantitative assessment at small scales are an ongoing and recognized challenge for many SIDS (Foley 2017).

TASK 2: Quantitative and Semi-Quantitative Assessment of Socio-Economic Impacts on Caribbean Fisheries

The socio-economic impact assessment is highly coupled to the ecological component through a fish chain framework. The framework consists of three stages: pre-harvest (marine ecosystem), harvest stage (fishing and capture activities), and post-harvest stage (processing, marketing, and consumption) as shown in Figure 4.

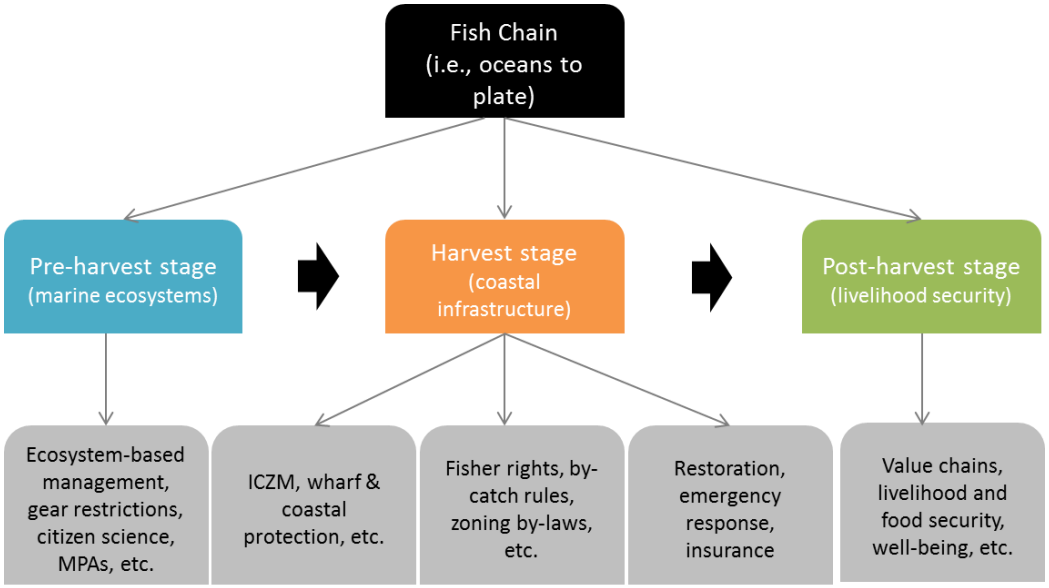

Figure 4: The Fish Chain showing the various production stages and interlinkages (Bavinck et al., 2007) and entry points for improving adaptive capacity / climate resilience (from Khan et al., 2016)

Assessing socio-economic impact potential (*exposure* and *sensitivity*) and *adaptive capacity* will involve value chain analysis in the harvest and post-harvest stages and economic impact assessment at the micro and macro level.

Sub-Task 2.1: Value Chain Analysis

As outlined in ESSA's Technical Proposal, the value chain methodology draws from Khan (2012) and starts with an examination of trophic dynamics and species abundance. Evaluation of socio-economic *exposure* of multiple seafood value chains for major commercial and subsistence species to climate change impacts will rely on modelling and analytical outputs of the ecological impact assessment, including maximum catch potential (MCP) and other spatial migration attributes. We will explore expected climate exposure of

fisheries infrastructure and fishing communities to direct climate impacts (e.g., through storm activities, ocean acidification, and loss of revenue) using historic loss and damage data. This provides a starting point to understand the policy and governance implications toward new quotas and landings, costs and earnings by fleet or gear types, trade flows across national and international markets, food consumption, seafood supply chain networks and organizational structure, and institutional mechanisms that builds adaptive capacity and promote both ecological and social resilience.

Evaluation of socio-economic *sensitivity* will be captured through a seafood value chain and livelihood analysis drawing upon viability assessments across the harvesting, processing, and marketing sectors. Multiple drivers including climatic and non-climatic stressors especially market forces simultaneously interact to impact and exacerbate human well-being and their dependence on fishery resources. The value chain analysis will explore key drivers affecting harvest rates and resource supply, processing requirements and consumer markets for various seafood products. Exploring these dimensions is essential for understanding economic viability, issues around insolvency, savings and capital assets (DFO, 2007), subsidies and safety nets, seasonal and long-term labor mobility across sectors, gendered responsibilities, and opportunities for integrated livelihood such as with recreational fishing and tourism (Cisneros-Montemayor and Sumaila, 2010). An extended economic viability approach will be employed that goes beyond individual fishers and processors or firm benefits, to overall household dependency and community resilience (Schuhbauer, 2017). The value-addition of our proposed approach is the attention given to institutions and entry points for climate adaptation responses and monitoring that can redress disconnects between place-based adaptation planning and sector-based fisheries management (Khan *et al*., 2016).

The socio-economic *adaptive capacity* of the fisheries sector will be based on socio-economic survey data, which may either be historical data where this is available or new data collected as part of this project. To be thorough and systematic, we will use a qualitative diagnostic tool to elucidate ecological and social vulnerabilities relating to the fisheries sector and associated governance mechanisms for adaptive capacities. The tool consists of a matrix of key defining attributes (diversity, complexity, dynamics, scale, and sensitivity) modified to the fisheries value chain framework (pre-harvest, harvest, post-harvest stages). It is assumed that the more diverse, complex, dynamic and multi-scale the systems are, the greater the need for building adaptive and promoting effective governance mechanisms.

As mentioned in Phase II: Task 1 we will rely on secondary collated data as well as primary data (e.g., census data), where available. Primary data collection will also comprise field work through key informant interviews and focus groups of actors across the fisheries value chain. Field work will take place over ten days, ideally before the 2018 hurricane season, and will involve two ESSA team members. Field instruments will be developed with open and closed questions on the key thematic issues as detailed in Cinner *et al*., (2013) on social indicators of vulnerability and adaptive capacity.

- Demographics, including gendered roles and vulnerabilities
- Psychological and social wellbeing (contentment, attachment to place, & social networks)
- Human agency affecting viability and livelihood security along the value chains for various species and gear types (NGOs, boundary organizations, unions, mediators, etc.)
- Access to credit (formal and informal, revolving funds e.g., rotating savings and credit association, co-financing, etc.)
- Livelihood sensitivity (e.g., dependence on marine-derived protein for food security, dependence on fisheries sector occupations for livelihood, occupational diversity and mobility both within the fisheries sector (i.e., to a different type of fishery) and across other coastal and marine activities and livelihoods
- Material assets (business capital assets, local housing, fishing vessels and gear)
- Property rights, rules of engagement, and use of coastal-marine space
- Technology and innovation (gear types and selectivity, vessel engine travel range, etc.)
- Essential infrastructure / loss and damage (processing plants, wharves, roads, bridges, etc.)

- Trust (between and amongst stakeholders and community members, managers, enforcers, etc.)
- Debts and level of insolvency, unemployment insurance / safety nets, etc.
- Willingness to take risks or to be prudent (attitudes), capacity to foresee and respond
- Vertical and horizontal linkages (cross sectoral partnerships, multi-level institutional arrangements, and climate mainstreaming and policy integration).

To respect cultural diversity and develop ethical procedures, protocols on how to conduct interviews will be assessed with the Client Task Team and Caribbean-based members of the ESSA Project Team. We will also work with the Client Task Team and national fisheries officers (ideally, project committee struck following the Regional Planning Workshop) to determine the most appropriate points of contact with local stakeholders at pilot sites (e.g., the president of a local fishing cooperative) and will coordinate with this point of contact to arrange interviews or meeting appointments with other members of the community. Such an approach will (1) assure that appropriate steps are taken to protect the rights and welfare of people participating as subjects in our study; (2) assesses the ethics of the research and its methods; (3) promote informed participation; and (4) allow the ESSA Project Team to use the data collected by the team for future work.

The primary and secondary data will be analyzed using various geospatial (e.g., climate hotspot and livelihood mapping using various GIS layers of social and ecological threats), statistical and content analysis tools to highlight community-based vulnerability profiles and adaptive capacity and to explore windows of opportunities and leverage points for climate resilience.

Overall, steps involved in undertaking value chain analysis are as follows:
- Review contextual variables and gap analyses for socio-economic impact assessment (e.g., demographic data, household and community profiles, social and material well-being, etc.);
- Identify baseline indicators for analysis and sources of data;
- Develop field instruments and conduct key informant interviews and focus group discussions;
- Collate quantitative secondary data from databases, government reports and policy documents;
- Compute cost and earnings and viability assessments for multiple commercial species;
- Visualize marketing and distributional networks for various seafood products under various scenarios;
- Assess nodal points along the fish chain and amongst stakeholders regarding quotas and harvest rules under climatic change impacts, price setting options, processing requirements and food safety standards, product quality and niche market development; and,
- Summarize and report methods and findings.

Analytical outputs will be available at multiple levels (see below) and integrated with findings from other WP1 research activities.
- Regional level (e.g., species extinction rate or migration range of commercial species and related trade and resource-sharing implications in monetary metrics);
- National level (seafood contributions to and losses for national gross domestic product);
- Local community level (livelihood integration of fisheries and other non-fisheries activities such as tourism or agriculture); and,
- Household and individual level (household loss / gains in fisheries income, i.e., fishing, processing, or marketing).

<u>Sub-Task 2.2: Economic Impact Assessment</u>
As stated in the ESSA Technical Proposal, the economic impact assessment will include two components: (1) direct socio-economic impacts and (2) assessment of physical flow-on socio-economic impacts.

Direct impacts refer to impacts felt by individuals, families and businesses directly engaged in the commercial and subsistence fishing. Examples of direct socio-economic impacts include changes to production output, as measured by MCP of particular species or ensembles (derived through ecological impact modelling); employment (location, availability, and types of work); household and business income; seafood availability (component of local diet); and, social wellbeing (attachment to place, access to social networks). Direct socio-economic impacts of interest are 'tangible' (i.e., have an observable market price component), while others are 'intangible' (i.e., not associated with an observable market price). Our approach to direct economic impact assessment remains the same as what we proposed initially: "effect-by-effect" approach, meaning that the method of analysis will be case specific. Tangible direct impacts, in general, are estimated as the product of a change in a quantity indicator, such as mean per vessel landing weight, vessel physical productivity, employment (with the change attributable to climate change or variability) and an appropriate unit value, such as landing prices or wages). Some of these tangible impacts may be generated through the value chain analysis, requiring close coordination among the ESSA Project Team.

For any external shock to a regional economy, like that caused by climate change and variability, there are several impacts beyond the initial effect, including induced consumption effects and indirect production effects. These are "flow-on impacts". For instance, a reduction in fishing activity in a community may mean less income for businesses that repair boats or supply diesel fuel, with possible further negative impacts on regional economic activity. We will use input-output (I-O) modelling to measure flow-on impacts resulting from the direct (tangible) impacts.

The ESSA Project Team has not yet defined the scope of either direct impact (i.e., which endpoints or effects to focus on) and flow-on impact assessment. To an extent, the scope depends on the ecological modelling outputs and scope of the value chain analyses. Waiting for further detail on the scope of value chain analyses is prudent because we want to avoid double counting in the case for multiplier effects or macro-economic modelling.

Discussions during inception meetings surfaced a number of questions that the team will focus on answering after the Regional Planning Workshop and as assembly of data continues:

- One option is for the economic impact assessment to "piggyback" on the fish chain approach: assessing vulnerabilities across social and ecological systems, stakeholder groups (fishers, processors, buyers, etc.), species and stock types, fisheries (as a sector), fishing communities, and ecosystem types (reef, offshore pelagics, inshore demersals, etc.). However, what is the feasibility of doing a physical flow modeling across the value chain, using social and economic variables, and market and non-market indicators?
- When assessing direct and indirect cost related to loss and damage from climate events ideally, we need access to data on the cost of critical infrastructure repairs, operational costs and expenses with longer trips fishing, fuel cost, etc. and cascading effect across sectors/communities/actors? Will we have access to sufficient data to capture these impact pathways?
- To what extent can we embed gender in the value chain analyses and economic impact assessment (micro)? Distribution of roles and access to and control over resources are highly gendered in Caribbean fisheries sectors. Gaining access to sex-disaggregated data, however, will be challenging. At a minimum, in running stakeholder engagement activities, including primary data collection for the value chain analysis, we will strive to hear from men, women and youth of both sexes.

Phase IV: Reporting

Reporting for this phase will be compiled throughout the research activities therein, and assembled in the final stages of this phase into a multi-volume report providing a comprehensive and holistic assessment of the climate change impacts and vulnerabilities facing Caribbean fisheries both across the region and within

the PPCR countries. The information from these output products will be used to inform the remaining work packages.

We anticipate the structure of the reporting outputs roughly following this draft outline.

- **VOLUME I: Overview of Climate Change Impact Pathways in Caribbean Fisheries**
  (outcomes of the qualitative pathway of effects conceptual modelling with supporting literature review narrative. This report will help to identify the most important pathways of climate change impact as well as key leverage points for management intervention).
  - Introduction to Conceptual Models
  - Ch 1 – Reef Ecosystem
  - Ch 2 – Mangrove / Seagrass Ecosystems
  - Ch 3 – Pelagic Ecosystem

- **VOLUME II: Climate Change Vulnerability and Impact Assessment for Caribbean Fisheries**
  - Introduction
  - Ch 1 - Regional Trends in Ecological Climate Change Vulnerability of Key Caribbean Fisheries Species
    (general regional outcomes of the quantitative biophysical impact and vulnerability modelling)
  - Ch 2 - Regional Trends in Socio-Economic Climate Change Vulnerability of the Caribbean Fisheries Sector
    (general regional outcomes of the value chain analysis and other socio-economic impact assessment)
  - Ch 3 - National Profiles of Climate Change Impacts and Adaptive Capacity
    (including national-level inferences that can be drawn from regional modelling, interpreted in the light of mitigating ecological and socio-economic factors within a national context based on supporting scientific datasets and the outcomes of national and community-scale socio-economic surveys, value chain analysis, and other studies. These national profiles will also offer high-level insights on priority fisheries species or habitats for management intervention and preliminary thoughts on potential approaches to adaptation. The final format of these profiles is yet to be determined, but will strive to present the information in an accessible "report card" format.)
    - Jamaica
    - Haiti
    - Dominica
    - Saint Lucia
    - Saint Vincent and the Grenadines
    - Grenada

3.3 Work Package 2 - Developing a Climate-Smart Fisheries Monitoring System

Objective 2:	Develop tools and methods for fisheries and marine ecosystem analyses and assessments to quantify the current and future impacts of climate change and variability on fisheries production, post-harvest and marketing systems and associated livelihoods
Objective 3:	Train regional experts in the use of the tools and methods developed to conduct fisheries and marine ecosystem analyses and assessments
Objective 4:	Develop a fisheries and environment database and supporting guidance (associated meta-database, user manual, recommendations on software and equipment)
Objective 5:	Train regional experts in the management and use of the fisheries and environment database

As noted in ESSA's Technical Proposal much of the work in the Work Package will take place in year 2 of the project. This section focuses on the critical activities during Phase I (Scoping the Climate-Smart Fisheries Monitoring System) that must take place in parallel with and closely following the work in WP1. **During the third quarter of year 1 we will submit a detailed plan for WP2**.

Overall, successful delivery of tasks and activities of WP2 will contribute to achieving project objectives 2-5.

Phase I: Scoping the Climate-Smart Fisheries Monitoring System

TASK 1: Extended Consultations

Sub-Task 1.1: Consultations Prior to the Regional Planning Workshop

Prior to the Regional Planning Workshop, the ESSA Project Team will initiate the process of defining the scope of, and implementation options for, the monitoring system. This project cannot resolve all of the issues currently facing fisheries data management in the region but we do intend to leave behind useful tools and systems that can augment what is currently in place and ideally provide useful examples that can built on. We will undertake the following activities:

- Identify key people to interview to better understand current data management systems (related to fisheries and natural resources management) and challenges in the region and the six PPCR countries.
- Engage with technical experts at the CRFM Secretariat, at the country level, and with academic groups such as CERMES at the UWI Cave Hill campus and key regional initiatives such as WECAFC FIRMS, to understand the status of existing and proposed marine and fisheries data gathering and database initiatives and how they might interact with our project.
- Specifically learn more about CARIFIS, its status, plans for its future, and how we might be able to leverage the existing infrastructure.

We will continue these discussions at the Regional Planning Workshop. We expect that this event will help us gather information and make connections with key people in the region, in order to continue discussions on options as scoping unfolds.

Sub-Task 1.2: Regional Planning Workshop and Subsequent Interviews

Throughout the process of defining the monitoring system we will consult with potential end users. It is important that we leave behind tools that can and will be used given the level of training and resources available. The Regional Planning Workshop is a key opportunity for consultation. Topics we propose to explore at the regional workshop with regards to the monitoring system and database include:

1. Present options for what we might be able to leave behind so that participants have a clear understanding of the range of possibilities with this project.
    a. Data from the study including inputs for climate modelling and fisheries data.
    b. Outputs from the study including things like future spatial distributions of species, local invasions and extinctions.
    c. Monitoring data gathered on a regular basis to examine the status and trends of climate-related indicators and potentially the effectiveness of management actions.
2. Discussion of what would be most useful for countries and regional organizations. What tools do they want/need to help them do their jobs and specifically to make more climate smart management and policy decisions? How might they use this sort of data? What types of reporting would be useful for them?
    a. Regional databases,
    b. Shared online tools for data access, and
    c. Local data entry tools and databases.
3. Status of existing regional systems and opportunities for integration:
    a. CARIFIS,

    b. CERMES – UWI Cave Hill Campus, including the Caribbean Protected Areas Gateway, and
    c. Others identified by participants and research before the workshop, e.g. WECAFC-FIRMS.
4. A discussion of issues that currently prevent data sharing and effective use of data including:
    a. Institutional barriers to sharing data between agencies and countries,
    b. Lack of standardized requirements and data format including the need for local variations in requirements,
    c. Lack of technical resources, and
    d. Lack of trained personnel both to use systems and to maintain them in country.
5. Options for implementing the database and tools from our project. For example, a centralized system and/or a disaggregated set of tools to assist with data collection, management, and exchange.
6. A decision on pilot study sites to focus on for the database component.

A review of previous assessments of climate, ecosystem, and fisheries database initiatives in the Caribbean Region and other island nations will also guide our scoping choices. These assessments highlight important user needs, implementation challenges, and barriers to ongoing use as well as provide recommendations for best practices in such environmental monitoring and management database projects that will inform the work that lies ahead. Key references of this nature we have already identified include:

- Overview of the Status of Performance of CARIFIS in CRFM Member States, and Options for the Way Forward (CRFM, 2012)
- Caribbean Open Data Scoping Study: Fisheries and Marine Protected Areas (MPAs) (Mallalieu and McConney, 2015), and
- Development and Implementation of A Climate Data Management System For Western Pacific Small Island Developing States (Martin et al., 2015)

Sub-Task 1.3: Coordination with Work Package 1 Activities and Outputs

In the first months of the project we will work with the team developing the ecological and socio-economic components of WP1 to define what data inputs and outputs could be usefully included in the final database. This process has already started and dialog will continue. This will help us to ensure that the designs and implementation approaches we are considering for the monitoring system can accommodate these data. For example, it is already clear that there will be a geographical and temporal aspect to both the input climate forecast data and the predicted species ranges in the future. We will need to ensure tools are available to manage and display this combination of attributes.

Task 2 of WP2-Phase I is focussed on the development of the monitoring framework; specifically, the selection of indicators and variables proposed to be measured and the statistical design requirements for the monitoring. Much of this will be developed after the completion of the WP1 products it is important that the specialist who will be leading the design of the monitoring plan (ESSA Project Team member Darcy Pickard) is engaged earlier and there is an ongoing dialog.

As potential questions to be addressed by monitoring are surfaced through understanding of impact pathways it is important that these are considered for feasibility and practicality early on. We will take an iterative approach, where proposed uncertainties and questions and indicators are reviewed to determine the levels of sampling and rigor required in related monitoring. It may be that in some cases it is not possible to sample at the required intensity and it will be necessary to consider alternative indicators or reformulate questions or their spatial or temporal scope to reflect practical levels of technology and effort.

TASK 2: Monitoring Framework, Tools, and Guidance

Sub-Task 2.1: Selection of Key Ecological and Socio-Economic Indicators for Ongoing Monitoring

Based on the outputs of WP1, our team will identify a subset of key ecological and socio-economic indicators that contribute to resilience of the fisheries sector to climate change impacts. These indicators will form the basis of a standardized regional monitoring system that can be implemented at the national scale to track both the status

and trends of Caribbean fisheries over time and to evaluate the effectiveness of future climate change adaptation interventions. Important considerations in the selection of these indicators are as outlined in the Technical Proposal, including aspects of relevance to management and feasibility of monitoring implementation across the range of capacities represented among PPCR countries and communities. Examples of such indicators might include:

- For the ecological component: species (e.g., biomass, size), habitat (e.g., rugosity, coral to microalgae cover) and ecosystem level (e.g., species richness, size distribution) metrics (see Cinner *et al*., 2013).
- For the socio-economic component: household and individual level (e.g., loss in fisheries income attributable to climate-related hazards), community level (e.g., extent of livelihood integration of fisheries and other non-climate-sensitive activities) and national level (e.g., fisheries management and development plans updated to account for future climate considerations).

Sub-Task 2.2: Design of a Regional Climate-Smart Fisheries Monitoring System

For the highest priority indicators and associated monitoring activities, we will then seek to identify and (where necessary) propose refinements to existing monitoring programs, which already capture the required information to capitalize on existing monitoring capacity and momentum (e.g., the many regional reef assessment programs identified in Work Package - 1 Phase II – TASK 1). Where suitable monitoring programs do not already exist for the desired status and trends indicators, we will refine or develop the core building blocks of the monitoring system (i.e., indicator, sampling design and response design).

Importantly, as identified in our Technical Proposal, monitoring activities will be grouped into tiers based on their ability to address the identified needs at different levels of capacity. Often a coarse assessment is possible at a broad spatial scale but more rigorous approaches are too costly or may exceed local capacity. The feasibility of various monitoring activities within the various national contexts will be determined in consultation with regional fisheries delegates from each PPCR country.

We will also identify any important next steps and implementation considerations necessary to implement the pilot monitoring programs and eventual full-scale monitoring system implementation.

Sub-Task 2.3: Development of Tools for Mainstreaming Climate Change Adaptation into Fisheries Management

The monitoring system design will also provide detailed guidance for how climate change and climate variability can be incorporated into existing models and decision-making processes used in Caribbean fisheries and marine ecosystem assessments. The specific models and processes to be considered will be identified through WP1 and may include such things as stock assessment, harvest-optimization models, and in-season management rules for specific species. For each of these models and processes we will provide guidance on practical approaches for incorporating aspects of ecological vulnerability, sensitivity and recovery potential into the existing assessment processes so as to "mainstream" climate change considerations into the routine Caribbean fisheries assessment and decision-making processes.

3.4 Work Package 3 – Facilitating Stakeholder Access and Contribution to the Information Base for Climate Change Adaptation and Disaster Risk Management in Fisheries

Objective 5:	Build stakeholder awareness on the impacts of climate change and variability on the fisheries resources and sector
Objective 6:	Engage stakeholders in identifying feasible recommendations for climate-smart fisheries management and decision-making.

This Work Package focuses on the development of and reporting on a dynamic communications and stakeholder engagement strategy that delivers practical information on how climate change is affecting the Caribbean fisheries sector, in a manner that engages and mobilizes the diverse target populations toward strategic action. It contributes to project objectives 5 and 6. Although climate change is a global problem

with wide-ranging impacts, this initiative will seek to anchor the global issues firmly within the context of the Caribbean fisheries sector, and specifically as it impacts on the six PPCR countries of Dominica, Grenada, Saint Lucia, Saint Vincent and the Grenadines, Jamaica and Haiti. This section of the report focuses on Phase I (Planning) and Phase II (Implementation) of this Work Package; related activities will unfold in year 1 of the project. **During the third quarter of year 1 we will submit a detailed plan for the remaining phase of WP3**.

Phase I: Planning

TASK 1: Establish a Baseline of Knowledge Attitudes and Practice

The first step in our strategic communication process is to design and administer a Knowledge, Attitudes and Practice (KAP) Study. This baseline assessment aims to identify key parameters that define the target audiences' frame of reference, and illustrate the key issues that must be addressed in designing a responsive and engaging communication campaign. Recent studies, including a series of USAID-sponsored rapid assessments of the fisheries sector in Jamaica, Haiti, Grenada and Saint Vincent and the Grenadines, have highlighted that while fisheries are being affected by climate change in multiple and significant ways, the sector has been slow in responding. Therefore, significant scope exists to influence changes in knowledge, attitudes and, ultimately, behaviour, toward climate-smart practices across the fisheries value chain in the six PPCR countries.

Table 4 below highlights the shifts in attitudes that need to be achieved in order to face the challenge of engaging with stakeholders on climate-smart fisheries. WP3 activities will be designed to help with the shift in knowledge and attitude that is outlined below. The contents of this table will be refined as planning and understanding of needs evolve.

BEFORE (Where We Are)	→	AFTER (Where We Want to Be)
People aren't clear what causes climate change.	→	People understand climate change and what is causing it
People don't understand what needs to be done to tackle climate change	→	People know what they can do to adapt to climate change
People don't include climate change as an important issue when making decisions.	→	People include climate change when making their decisions and embrace the positive changes that may result
Climate change is a depressing and negative issue.	→	People feel empowered and positive about tackling climate change
People aren't clear on the contribution the fisheries sector makes to national and local economies	→	People take action to build the sector's climate resilience

Table 4: Proposed shifts in knowledge, attitudes and practice guiding communications activities

Sub-Task 1.1: Establish Target Audiences and Sampling Strategies

Sustained Engagement is one of three core principles underpinning WP3 activities (and the project overall). This means that we need to make our best efforts to ensure ongoing contact with targeted groups to nurture the effective building of the necessary skills to promote autonomy and uptake of project results. Inception activities helped understand the range of stakeholder groups to engage in WP3 activities, which we show in Table 5. Target groups are diverse so we will need to identify a system / process that serves to identify precise needs and proposes real solutions cost-effectively. We are pursuing options with a Caribbean-based ICT professional, with a view to exploring existing tools that might be applied/ adapted for this purpose. The stakeholder matrix below will evolve into a series of profiles by target audience,

including specific communications objectives and timing and format of engagement with each group at different stages as the project evolves (i.e., linked to the project life cycle).

Because of budgetary realities, it will not be possible to establish baselines for all target groups in all PPCR countries. Our current thinking is that we will focus efforts on pilot study sites, the selection of which will happen at the Regional Planning Workshop.

Sub-Task 1.2: Construct the Study Protocol

This involves defining indicators for all aspects of knowledge, attitudes and practice that need to be assessed. To develop questions, we will draw on early outputs of WP1 as well as literature and program lessons on climate-smart fisheries practices of relevance to the Caribbean. Given the low levels of awareness/ lack of understanding regarding the science of climate change it will be important to translate the complex and technical into terms and messages that the respective target audiences can understand. The following are the types of resources we will consult in developing the study protocol:

- Gaichas *et al*., 2016, which provide concrete examples of fisheries management actions to reduce climate risk based on the nature of the risk;
- Heenan *et al*., 2016 describe activities required to maximize the effectiveness of ecosystem approaches to fisheries and aquaculture as strategies to adaptation to ocean acidification;
- Pinsky and Mantua, 2014 describe challenges to and approaches for incorporating climate and acidification considerations into fisheries management;
- Paice and Chambers, 2016 provide information to support climate change adaptation planning for coastal ecosystems, including in tropical environments;
- Mercer *et al*., 2012 discuss ways to integrate local and external knowledge into ecosystem-based approaches to adaptation in SIDS;
- Miller *et al*., 2018 discuss characteristics of marine adaptation strategies and factors influencing their implementation, including drivers, strategy, timeline, costs, and limitations;
- McConney *et al*., 2015 propose a series of project concepts to accelerate climate change adaptation and disaster risk management in fisheries and aquaculture in the CARICOM and wider Caribbean region.
- CRFM, 2013 assesses and summarizes findings on CARICOM countries' vulnerability to disasters and climate change.

As we develop and roll-out the Stakeholder Engagement and Communication Strategy we will continue to compile Caribbean-specific information on strategies and actions to promote climate resilience of the fisheries sector, as well as barriers and enablers to implementation.

How could the stakeholder block the project?	**Stakeholder Name** (organization or group)	**Impact** *How much does the project impact them? (Low, Medium, High)*	**Influence** *How much influence do they have over the project? (Low, Medium, High)*		**What is important to the stakeholder?**	**How could the stakeholder contribute to the project?**	**Strategy for engaging the stakeholder**	**Indicators** *that are specific, measurable, achievable, realistic within project timelines (SMART)* *(SMART objectives will be developed for each target group)*
Refusing to support initiatives/ stonewalling policies	Policy makers/ legislators Caribbean Fisheries Forum and Ministerial Council	Medium/ High (depending on importance of fisheries to their constituency/ strategic positioning	High		Visibility; Votes; economic viability	Shepherding/ Championing project; networking	Interview, cultivating relationship with PM; encouraging buy-in/ ownership of project	# of policymakers engaged in project; ongoing interactions to build visibility of fisheries sector
Sowing seeds of doubt/ distrust; refusing to give access to network/value chain	Fisheries Officers	High	High		Fulfilling professional mandate, sustainable relationships with players along value chain	Key informant interviews - providing historical references/ insights; access to network/ value chain	Consultation (individual or in group)	# of officers interviewed, coopted into the project
Create doubt, distrust, rumormongering	Fisher folk	High	Medium		Improved access to resources, improved earnings and livelihoods (e.g. better working conditions, safety)	Key informant - providing data on catch, observations re climate trends/ changes in environment	Consultation/ Interview	# of fishermen surveyed in KAP; # of key informants interviewed
Create doubt/ distrust; stonewalling	Fishing Cooperatives/ Association/ NGOs	High	High		Improved capacity for leadership, cohesiveness,	Key informants; publicity; creating	Consultation	# of key informants interviewed;

Refuse access to information					buy-in from members; championing the project	interest/ support among members/ community		Organizations involved in project (stakeholder list at start, mid, end)/
Refuse access to information	Fish Vendors/ Middle men	High	Medium		Access to catch at an affordable price/ profit; improvement of catch quality	Key informant - supply/ demand/ price	Consultation/ Interview	# of vendors/ middlemen interviewed
Refuse access to information	Fish Processors	High	Medium		Access to catch at an affordable price/ profit; improvement of catch quality/ quantity; consistent supply	Key informant interviews; providing data on volumes processed, data re export/ local consumption	Consultation/ Interview	# of fish processors interviewed, engaged in aspects of the project

Table 5: Preliminary stakeholder matrix to guide targeting of communications and engagement activities

Sub-Task 1.3: Collect, Analyze Data and Summarize Findings

Data collection instruments will consist of surveys, to be administered online or in person, depending on the target group. Prior to deploying the data collection instruments we will obtain feedback from the Client Task Team and participants at the Regional Planning Workshop. This event provides an opportunity to pre-test the KAP and focus discussion on some very specific aspects of the developing communications strategy (e.g., priority actions and corollary messages for further elaboration) to build buy-in for this component of the project. Once a decision on pilot study sites is made, we will mobilize national and local stakeholders at the 3 sites to roll out the KAP study, ideally with assistance of the project committee of PPCR representatives set up for this project. Data collection and analysis will take place over 8 weeks. We will use the outcomes of the KAP study to develop the Stakeholder Engagement and Communications Strategy.

TASK 2: Develop Project Stakeholder Engagement and Communications Strategy

Raising awareness of climate change impacts and best practices in climate-smart fisheries management are priorities for communications. However, this is a broad priority that will need to be broken down into digestible and actionable messages. It is essential that climate change messages are communicated successfully with a range of stakeholders at different levels. Recognizing that climate change often impacts men and women differently, the gender dimension must also be taken into account. In developing and rolling out the strategy we will take into account two additional principles underpinning WP3 activities:

- **Participation:** ensuring that the information generated for any activity or target group involves the 'voice' of the intended or impacted group. This ensures that as far as possible, there is engagement, buy in and ownership.
- **Creative Expression:** the use of the arts (music, spoken word, drama, etc.) is a strong way of bringing alive the climate change message in a manner that is more easily understood.

Sub-Task 2.1: Develop the Strategy

To develop the strategy, we will also seek lessons from climate change communications across the region. National PPCR programs include provisions for communications, however as these projects are still in the development stage, it is not yet apparent how much focus will be on fisheries/ the marine sector. However, another regional initiative, the Japan-Caribbean Climate Change Partnership (J-CCCP) that is being led by the UN Development Programme (UNDP), has cited marine related issues as a priority and efforts are being made to engage with fisheries stakeholders and to design responsive communications messages and outputs. For example in Saint Vincent and the Grenadines, recognizing that most of the population lives in low-lying coastal areas, and that many of these areas/ islands are dependent on fishing, messages in the JCCCP campaign focus on mangrove protection, highlighting key eco-system services, i.e., coastal protection against storm surges and provision of breeding grounds for fish, provided by healthy mangroves. In looking at initiatives that address climate change and fisheries, a major challenge is that Fisheries is often lumped together with Agriculture, Natural Resources or under other Ministries/ Government Departments, and the voice of the fisheries sector is weak (by implication, poorly considered in designing communications activities).

We will use the Tools of Change Planning Guide to develop the strategy, adjusting for regional, national and local relevance and project constraints (time and budget). This guide breaks down development of social change strategies or programs into the steps shown in Figure 5.

The strategy will be a succinct document that details what needs to be done, when, how, who is responsible and who we need to partner with to be successful. It will also be important to stay agile and flexible as the campaign rolls out in order to seize unforeseen opportunities to broaden our reach as they arise.

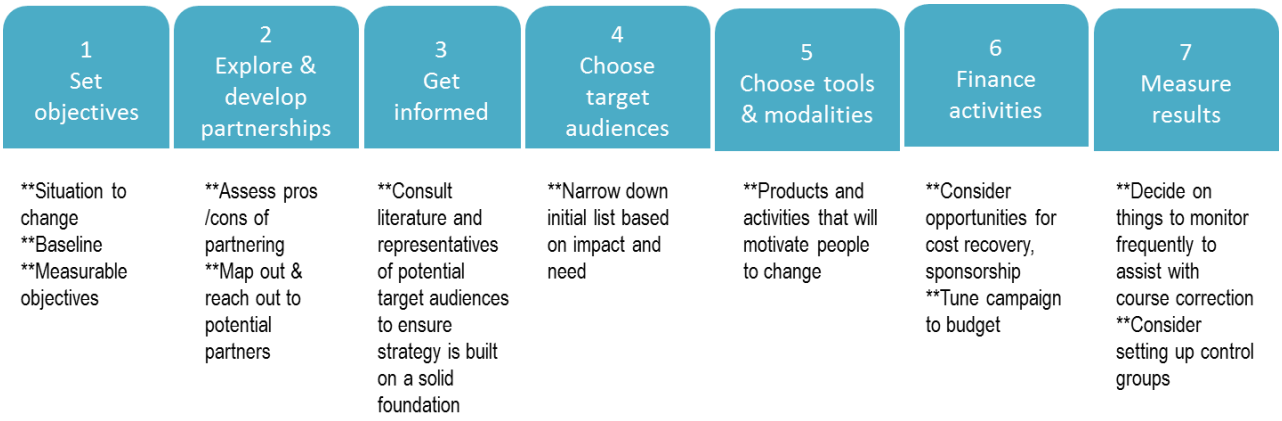

Figure 5: Steps in developing a strategy and program of work to support social change (modified from http://www.toolsofchange.com/en/planningguide)

Sub-Task 2.2: Prepare Campaign Materials

The Stakeholder Engagement and Communications Strategy will detail the products and modalities with most potential to further our objectives. Possible outputs include the following:

- **Banners/ posters and other visual aids** – these will encapsulate specific climate change messages designed with participation from key stakeholders. They will be designed for replicability and/or placed at strategic locations to be determined after further consultation with specific target groups.
- **Public Service Announcements (PSAs)** – these messages will focus on reaching low literacy audiences such as fisher folk around critical issues, promoting climate resilience.
- **Radio Drama** – by packaging climate change messages in a dynamic format, they will appeal to a range of target audiences (including low literacy). Radio has a wide reach across social groups and geographic areas (including offshore) and can be very cost effective.

Phase II: Implementation

The Technical Proposal outlines two tasks for this phase. Upon further consideration the Project Team has decided to bundle activities under one task area.

TASK 1: Implement and Monitor the Awareness-Raising Campaign

Communications and engagement activities will unfold over 12 months (from July 2018 to June 2019). We will work with defined target groups to develop specific messages to be used during and throughout the campaign. At the interim stage, the messages will be tested for effectiveness with focus groups, and adjusted accordingly. Once the messages have been finalized, they will then be incorporated into the campaign outputs. The campaign will include a few opportunities to engage with selected stakeholder groups to gather ideas, experiences and lessons on practices to adapt to climate change / variability and manage disaster risks along the fisheries value chain, potentially making use of social media tools. We will maintain a living inventory of climate-smart fisheries practices, combining findings from the literature and stakeholder perspectives.

The KAP will provide some baseline information on climate change awareness in the target countries. The initiative will ensure that there is ongoing monitoring of knowledge levels through the project implementation. This would take the form of pre and post tests for stakeholder engagements. This information would provide the base for a final evaluation at the end of the project.

3.5 Work Package 4 - Facilitating the Integration of Climate Risk and Resilience into Regional Fisheries Development and Planning

Objective 6: Engage stakeholders in identifying feasible recommendations for climate-smart fisheries management and decision-making.

WP4 does not include distinct phases. Tasks and activities contribute to scoping and to the closure phase of the project. A major output of WP4 is an updated Regional Strategy and Action Plan for Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture (CRFM, 2013a) that accounts for the new information gleaned from project research as well as the aspirations and capacities of Caribbean stakeholders across the fish value chain. This WP contributes to project objective 6 and the receptiveness by stakeholders of the updated Regional Strategy and Action Plan will help evaluate our work against this objective. This section of the report focuses on elaborating on the first of three tasks under this WP outlined in the Technical Proposal. The other two tasks take place during year 2 of the project. **During the third quarter of year 1 we will submit a detailed plan for the remaining tasks of WP4**.

TASK 1: Understand Implementation Lessons

This task involves taking stock of the extent of progress in implementing Regional Strategy and Action Plan and understanding what has been learned as a result. As we have learned through inception activities, (1) climate change work in fisheries in the Caribbean is in early stages[1], (2) monitoring or reporting on implementation of the Regional Strategy and Action Plan is neither required, well-resourced nor common practice among CARICOM countries or regional bodies, and (3) gaps in accountability frameworks and reporting structures create challenges for systematically assessing implementation progress on the Regional Strategy and Action Plan. These last two factors can hinder sustaining the momentum of implementing a strategy.

As a first step in this task we sought to undertake a desk-based stock take of action items deemed to be high priorities for coastal and marine systems and fisheries and aquaculture in the 2013 Regional Strategy and Action Plan (see Table 6). The lack of centralized reporting and sheer number of actions to investigate (by our count 44 high priority actions) made it difficult to carry out this exercise efficiently and generate accurate results. Nevertheless, in reviewing the actions listed in the Regional Strategy and Action Plan we noted that the preponderance of actions relates to policy, governance and institutional change (see Figure 6), including actions to drive the incorporation of ecosystem approach to fisheries, climate change and DRM considerations in fisheries and marine resource management. Changing the regional and national institutional landscape will take time. It would not be surprising to learn that progress may lie in actions that yield tangible results in the short term.

To understand implementation status and lessons we will reach out to national fisheries representatives of the PPCR countries prior to Regional Planning Workshop. We will request a one-hour Skype interview with them and share a template with them in advance (a portion of this template is in Table 6) so they can self-identify the actions that have moved forward in their country. The interview will centre on three broad areas of inquiry:

- does the PPCR program include fisheries-related projects and what has and has not been implemented, as planned;
- what has enabled and constrained implementation of climate resilience initiatives in fisheries and marine resource management;

[1] Projects to highlight are as follows: parametric hurricane insurance under the Caribbean Ocean and Aquaculture Sustainability Facility (COAST); the Climate Change Adaptation in the Eastern Caribbean Fisheries Sector (CC4FISH) Project funded by the Global Environment Facility (GEF); the ICT-based early warning system designed to reduce fisher folks' vulnerability to the impacts of climate change (a regional track PPCR project); and the development of a regional protocol to integrate climate change adaptation and disaster risk management in fisheries and aquaculture into the Caribbean Community Common Fisheries Policy.

- what has worked well in advancing climate resilience initiatives in fisheries and marine resource management and why; and,
- how useful has the 2013 Strategy and Action Plan been in mobilizing attention and resources toward implementation of climate resilience initiatives in the sector.

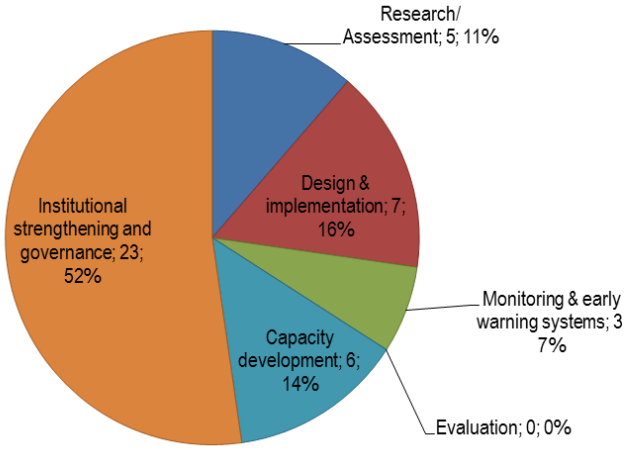

Figure 6: Distribution of "high priority" actions identified for coastal and marine systems and fisheries and aquaculture in the 2013 Regional Strategy and Action Plan

We understand that the CRFM is hosting a regional workshop on April 18, 2018 in Montserrat, to review and validate a newly-developed protocol to integrate climate change adaptation and disaster risk management in fisheries and aquaculture into the Caribbean Community Common Fisheries Policy. The topic of this workshop is highly relevant to the work under WP4; we will request documentation on meeting outcomes from the CRFM Secretariat.

Information gleaned from the task described here would help seed early discussions on decision-support needs (WP2) and help the team define ways to improve the effectiveness and impact of the Regional Strategy and Action Plan.

Strategic element 1: Mainstream climate change adaptation strategies into sustainable development / agendas of CARICOM Member States									
Action	**Sector or Area**	**Activity Level**	**REG**	**JAM**	**HAITI**	**SVG**	**GRE**	**DOM**	**SLU**
Goal 1: Assess the vulnerability and risks associated with a changing climate ***Objective: Manage the adverse effects of climate change on coastal and marine resources*** ***Outcomes:*** ***• Coral reef research programme institutionalized and providing data to guide scientific research by 2021*** ***• Increased output of peer reviewed and published research for contribution to teaching of climate science and to IPCC use***									
Establish a functioning network of Coral Reef Early Warning Systems (CREWS) in selected countries. In addition to Jamaica stations, installations should include Belize, Barbados, Tobago and Saint Lucia	CZM	Regional	[2]						
Monitoring in all countries with coral reef is institutionalized between UWI Centre for Marine Sciences and national agencies	CZM	Regional National	[3]						

Table 6: Template to collect information and assess progress on implementation of the Regional Strategy and Action Plan. What is shown below is an example focusing on two actions and our interpretation of progress based on desk-based review of publicly-available sources, which are listed as footnotes. The colour coding indicates three levels of progress (green = implemented; orange = partial implementation; red = not implemented). Completing the template for all high priority actions will require self-reporting by national representatives, as an additional information source.

[2] "The Climate Change phenomenon is becoming more evident, with increasing ocean acidification and thermal stress affecting coral reefs with the result being coral bleaching. It is, therefore, critical to monitor the various parameters that impact the coral reefs in the Caribbean. Strong Coral Reef Early Warning Systems (CREWS) improve climate-risk planning, management and action necessary to address the impacts of Climate Change, especially coral bleaching. To this end, the Caribbean Community Climate Change Centre, through collaboration with the US National Oceanic and Atmospheric Administration (NOAA), is working to establish an integrated regional network of climate and biological monitoring stations to strengthen the region's early warning mechanism. Under the MACC and EU-GCCA projects seven (7) Coral Reef Early Warning System (CREWS) stations have been installed in Barbados, Belize, Dominican Republic, Jamaica, and Trinidad and Tobago." http://www.caribbeanclimate.bz/coral-reef-early-warning-system-crews-us900000/

[3] The Caribbean Coastal Data Centre (CCDC) of the Centre for Marine Sciences (CMS) at UWI, archives data on the coastal and marine resources for more than 30 countries in the Caribbean. The main areas of focus are the provision of data management services and technical support to coastal and marine projects in Jamaica and the wider Caribbean. https://www.mona.uwi.edu/cms/ccdc/ccdc.html NOTE: unclear how / whether the relationship has been institutionalized with national agencies.

3.6 Integration across Work Packages

Effective implementation of this project will require close coordination and integration across and within Work Packages. The introductory section of this report includes a schematic to show some of the inter-relationships (see Figure 1). The table below focuses on information flows and coordination requirements between Work Packages that we have identified so far. Preparation for and delivery of the Regional Planning Workshop and any webinars subsequent to it will require coordination across the Project Team; for simplicity, that is not reflected in Table 7.

We will use the table below to guide Project Team meetings and will update it as the project progresses.

From / To	WP1-Ecological	WP1-Socio-economic	WP2	WP3	WP4
WP1-Ecological		*Lists of key commercial and subsistence fisheries species to focus on *Ecological information to inform pilot site selection *Conceptual models & pathways of effects analysis showing management levers with promise *Indicators of extinction and invasion risk by species *Maximum catch potential by species *Qualitative information on regulation, legislation & management control to limit climate risk at national levels	*Data inputs and outputs could be usefully included in the final database *Emerging management needs and potential questions to be addressed by monitoring *Potential ecological indicators to monitor *Tools to incorporate ecological vulnerability, sensitivity and recovery potential into the existing assessment processes @Development of training program and materials related to climate-smart fisheries and marine ecosystem analyses and assessments @Training implementation	*Information on pathways of climate change impact in Caribbean fisheries for 3 ecosystems, to feed the KAP *Regional trends in ecological climate change vulnerability of key Caribbean fisheries species to feed the communications campaign *National profiles of climate change impacts and adaptive capacity to feed the communications campaign *Tailored graphics (science communications)	*Insights on priority fisheries species or habitats for management intervention and preliminary thoughts on potential approaches to adaptation
WP1-Socio-economic	@Integrated reporting		@Selection of pilot study sites *Data inputs and outputs could be usefully included in the final database *Emerging management needs and potential questions to be addressed by monitoring *Potential socio-economic indicators to monitor	@Selection of pilot study sites @Primary data collection in pilot study sites (alignment with KAP, other activities) *Regional trends in socio-economic climate change vulnerability of key Caribbean fisheries species to feed the	*Insights on climate change impacts on level of compliance and stewardship, discards rates, access rights, single versus multiple species rules, conflicts over price setting, processing requirements, tariffs and trade barriers and potential

From / To	WP1-Ecological	WP1-Socio-economic	WP2	WP3	WP4
				communications campaign *National profiles of climate change impacts and adaptive capacity to feed the communications campaign	approaches to adaptation
WP2	@Guidance on data & tool formats for seamless integration into climate-smart fisheries monitoring system	*Findings on existing databases on fisheries-related indicators to assess socio-economic dimensions in the Caribbean @Potential for GIS mapping of fisheries livelihood vulnerabilities @Guidance on data formats for seamless integration into climate-smart fisheries monitoring system		@Questions related to data sharing for the KAP study	@Interviews / discussion with national stakeholders for situational assessment (implementation of Regional Strategy and Action Plan AND data-sharing and monitoring for fisheries and marine resource management)
WP3	*Results of KAP study and of implementation of awareness campaign to inform messaging in integrated report	*Results of KAP study and of implementation of awareness campaign to inform messaging in integrated report	*Results of KAP study and of implementation of awareness campaign to help break down barriers to data sharing and effective use of data		*Results of KAP study and of implementation of awareness campaign to inform priorities and messaging in the updated Regional Strategy and Action Plan *inventory of climate resilience and adaptation measures applicable to Caribbean fisheries and marine resource management
WP4	*High-level information on current status of climate change adaptation and ecosystem approaches to fisheries	*High-level information on current status of programs and projects to build coping and adaptive capacity of fisher folk	*High-level information on potential information and decision-support needs	@Pre-test KAP study protocol with national fisheries representatives	

Table 7: Information flows and coordination requirements across Work Packages (information is denoted by "@" and coordination by an asterisk *)

4. PROJECT DELIVERY SCHEDULE

What follows are tables summarizing the timing and sequence of project tasks and activities, as well as a table listing expected timelines for submission of deliverables to the Client Task team. The Excel file underpinning the work plan and project schedule has been shared with the CRFM Client. The key to official project deliverables is in the fifth table of the series. In general, the focus of year 1 is on research and initiating communications and engagement. Year 2 focuses on the database and monitoring system and training, completing communications and proving policy and strategy recommendations to advance climate change adaptation and disaster risk management in the sector.

Task	Responsible	Status	Year 1: March 2018-February 2019											
			Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb
Phase I: Planning														
Task 2: Regional Planning Workshop														
Pre-interviews, Agenda, Seeding document	JE, TW, MN, NT, AK	In progress												
Two-Day Workshop in SVG	WC, TW, JE, NT, AGG	Not started												
One to Two follow-up webinars	TBD	Not started												
Regional Planning Workshop Report	NT, TW, AK, JE	Not started			1									
Phase II: Scoping and Qualitative Research														
TASK 1: Assembly of Available Data														
Climate	WC, GR, CW	In progress												
Ecological	WC, GR, CW, NT	In progress												
Fisheries	NT, AK	In progress												
Socio-economic	AK, RB	Not started												
Compendium of datasets	(Multiple contributions)	Not started									a			
TASK 2: Pilot Site Selection														
Develop Criteria	AK, CW, DC	In progress												
Select Pilot sites with Stakeholders	(Regional Planning Workshop)	Not started												
TASK 3: Qualitative Pathways of Ecological Effects Analysis														
Preliminary Conceptual Models	NT, CW, MM, MJ	Not started		b										
Full Qualitative Pathways of Effect Analysis & Report	NT, CW, MM, MJ	Not started				c								
Phase III: Impact and Vulnerability Assessment														
TASK 1: Quantitative Assessment of Ecological Impacts														
Identify Key Focal Fisheries Species for Modelling	WC, CW, NT	In progress												
Regional Ecological Modelling	WC, GR, CW, NT	Not started									d			
National-scale Summaries of Ecological Vulnerability	NT, CW, MM	Not started										e		
TASK 2: Assessment of Socio-Economic Impacts														
Baseline Characterization (inventory, indicators, gaps)	AK, RB, DC	In progress												
Value Chain Analysis - Bioeconomic, Secondary Data	AK	Not started												
Value Chain Analysis -Preparation & Field Research	AK, DC, AGG	Not started												
Value Chain Analysis Research Findings	AK	Not started											f	
Direct Impact - Effect by Effect Estimation	RB, JE	Not started												
Flow On - I/O Modelling	RB	Not started												
Economic Impact Assessment Summary Results	RB, JE	Not started											g	
Phase IV: Reporting														
Multi-Volume Report Compiling Research Results of WP1	NT, WC, MM, AK, RB, JE, MJ	Not started												2

Table 8: Work Plan and Delivery Schedule for WP1. Areas shaded in cream represent expected duration of tasks, whereas areas shaded in black represent expected duration of sub-tasks. Responsibilities are denoted by team members' initials. Numbers and letters correspond to official and interim deliverables, respectively.

Task	Responsible	Status	Year 1: March 2018-February 2019												Year 2: March 2019-February 2020						
			Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept
Phase I: Scoping the Climate-Smart Fisheries Monitoring System																					
TASK 1: Extended Consultations																					
Interviews Prior to Regional Planning Workshop	TW	In progress																			
Interviews Subsequent to Regional Planning Workshop	TW	Not started																			
Detailed Work Plan for Year 2	TW, JE	Not started							h												
TASK 2: Monitoring Framework, Tools and Guidance																					
Select Indicator Set for Ongoing Monitoring	DP, TW, NT, AK, JE, MJ	Not started																			
Design the Regional Climate-Smart Fisheries Monitoring System	DP, TW	Not started															i				
Tools & Guidance for Adaptation Mainstreaming	NT, MJ, WC, AK, RB	Not started																3			
Phase II: Design and Deployment of Climate-Smart Fisheries Monitoring Database and Tools																					
TASK 1: Design and Build	TW, HS	Not started																			
TASK 2: Data Upload	TW, HS	Not started																			
TASK 3: Meta-Database Development	TW, HS	Not started																			
TASK 4: Operational Guidance & Equipment Recommendations	TW, HS	Not started																			
TASK 5: Regional Fisheries and Environment Database	TW, HS	Not started																		4	
Phase III: Training Workshops for Database and Tools																					
TASK 1: Develop the Training Program	TW, HS, JE	Not started														j					
TASK 2: Implement the Training Program	TW, HS, NT	Not started																			
TASK 3: Report on Training Outcomes	TW, HS	Not started																			5

Table 9: Work Plan and Delivery Schedule for WP2. Areas shaded in cream represent expected duration of tasks, whereas areas shaded in black represent expected duration of sub-tasks. Responsibilities are denoted by team members' initials. Numbers and letters correspond to official and interim deliverables, respectively.

Task	Responsible	Status	Year 1: March 2018-February 2019												Year 2: March 2019-February 2020								
			Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct
Phase I: Planning																							
TASK 1: Establish a Baseline of Knowledge Attitudes and Practice																							
Establish Target Audiences and Sampling Strategies	AGG, DC, JE	In progress																					
Construct the Study Protocol	AGG, DC, JE	Not started																					
Collect and Analyze Data	AGG, DC	Not started																					
Report	AGG, DC, JE, NT	Not started				6																	
TASK 2: Develop Engagement & Communications Strategy																							
Develop the Strategy	AAG	Not started					7																
Prepare Draft Campaign Materials	AAG, NT, DC, JE	Not started																					
Detailed Work Plan for Year 2	AAG, JE	Not started							k														
Phase II: Implementation																							
TASK 1: Implement & Monitor the Awareness-Raising Campaign																							
Roll Out Campaign	AAG, DC, NT	Not started																					
Finalize & Submit Campaign Materials	AAG, DC	Not started																8					
Monitor	AAG, DC, NT	Not started																					
Phase III: Reporting and Preparing for Impact Evaluation																							
TASK 1: Report on Communications & Engagement Activities	AGG	Not started																	9				
TASK 2: Impact Assessment Tool	JE, AGG, DC	Not started																				10	

Table 10: Work Plan and Delivery Schedule for WP3. Areas shaded in cream represent expected duration of tasks, whereas areas shaded in black represent expected duration of sub-tasks. Responsibilities are denoted by team members' initials. Numbers and letters correspond to official and interim deliverables, respectively.

Task	Responsible	Status	Year 1: March 2018-February 2019												Year 2: March 2019-February 2020											
			Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb
TASK 1: Understand Implementation Lessons	JE	In progress																								
Detailed Work Plan for Year 2	JE	Not started							l																	
TASK 2: Updated Regional Strategy and Action Plan	JE, WC, AK, MJ, NT, DC	Not started																				11				
TASK 3: Final Technical Report	JE, TW, NT	Not started																							12	

Table 11: Work Plan and Delivery Schedule for WP4. Areas shaded in cream represent expected duration of tasks, whereas areas shaded in black represent expected duration of sub-tasks. Responsibilities are denoted by team members' initials. Numbers and letters correspond to official and interim deliverables, respectively.

#	Official Deliverable	Expected final delivery date to CRFM/MORI
	Work Package 1	
1	Regional Planning Workshop Report	May 7, 2018
2	Multi-Volume Report Summarizing Research on Fishery-Related Ecological and Socio-Economic Impacts of Climate Change and Variability	February 20, 2019
	Work Package 2	
3	Reports of Analytical Tools and Methods Developed and Applied for Incorporating Climate Change and Climate Variability Data and Information into Fisheries and Marine Ecosystem Analyses that also Incorporate Value-chain Considerations, including Updated Advice to Inform Climate Smart Fisheries Management Practices	June 24, 2019
4	Regional Fisheries and Environment Database with all project inputs and outputs uploaded as well as meta-database, together with supporting database manual	August 30, 2019
5	Reports of Regional Training Workshops (on fisheries and marine ecosystem analyses and assessments and use of the regional fisheries and environment database)	September 30, 2019
	Work Package 3	
6	Baseline Report of Knowledge, Attitudes and Practices (concerning fishery-related impacts of climate change and variability and best practices in disaster risk management in the fisheries sector)	June 24, 2018
7	Stakeholder Engagement and Communications Strategy and Action Plan	July 23, 2018
8	Stakeholder Engagement and Communication Materials (updated, as needed, based on implementation of engagement and communications activities)	June 30, 2019
9	Report of Stakeholder Engagement Strategy and Action Plan Implementation (including consultation reports, and including feasible stakeholder-driven recommendations for climate-smart fisheries management decision-making in the fisheries sector)	August 31, 2019
10	Impact Assessment Tool (tools for future evaluation of communication & engagement activities)	October 31, 2019
	Work Package 4	
11	Updated Regional Strategy and Action Plan for Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture	November 30, 2019
12	Final Technical Report	January 15, 2020

Table 12: Itemized list of official deliverables and expected delivery dates

#	Interim Deliverable	Expected Completion
	Work Package 1	
A	Compendium of climate, ecological, fisheries and socio-economic datasets	November 26, 2018
B	Preliminary Conceptual Models	April 20, 2018
C	Climate Change and Variability Pathways of Fisheries Impact Report	June 20, 2018
D	Draft Report Chapter on Biophysical Modelling Results (incl. data visualizations, implications for key fish, fisheries, and supporting habitats at the regional scale)	November 26, 2018
E	Draft Report on Results of National-level Qualitative Ecological Assessments for Each PPCR Country (six chapters)	December 17, 2018
F	Draft Report on Research Findings from Value Chain Analysis – Regional, National, Local Scale and Recommendations on Adaptation Mainstreaming	January 22, 2019
G	Draft Report on Research Findings from Economic Impact Assessment – Direct and Flow-On Impacts	January 22, 2019
	Work Package 2	
H	WP2 Work Plan for Year 2	September 17, 2018
I	Documentation of Monitoring Recommendations (e.g., sampling design approach, monitoring activities (tiers), and references to field protocols)	June 24, 2019
J	Analytical Tools and Database Training Program (learner profiles, learning objectives, modalities, training plans, materials need)	April 22, 2019
	Work Package 3	
K	WP3 Work Plan for Year 2	September 17, 2018
	Work Package 4	
L	WP4 Work Plan for Year 2	September 17, 2018

Table 13: Itemized list of interim deliverables and expected delivery dates

5. PROJECT GOVERNANCE

5.1 Project Management and Organizational Structure

Since contract signature we have undertaken a few steps to set up processes and norms for working together as a cohesive team, with several others planned. The project team consists of 15 specialists distributed in six cities spanning three countries (see Figure 7). Effective project management, strategic use of and clear communications across team members will be critical to reduce bottlenecks and ensure implementation proceeds as planned, on time and on budget. A first step in organizing the project has involved signing agreements with sub-contractors, with provisions carried over from the Client contract and statements of work, to help create clear accountabilities. The team leader has encouraged virtual sub-team meetings to initiate project scoping as well as relationship-building, and has created a Drobox folder to facilitate sharing of bibliographic references and documents. The overall approach to project management will be to encourage collective leadership over project delivery and maintaining communication lines open. The project team leader is the initial focal point for liaison with the Client Task Team, but direct contact between team members and the CRFM client on technical matters will be encouraged, as appropriate. Planned actions to ensure this project benefits from good practice in project management are as follows:

- Scheduling weekly check-ins with sub-team leads with a significant project workload. These weekly check-ins will help foster integration across Work Packages, identify and try to resolve bottlenecks, provide a venue to provide constructive feedback and reflect on successes and failures during implementation;
- Activating the project in Trello, a web-based project management application, and using this medium to keep team members current on completed and upcoming tasks;
- Creating a WhatsApp project group, for quick exchanges among team members;

- Developing templates for project outputs and internal tools (generic Word project report, generic PPT presentation, mission report template);
- Establishing a travel plan and identifying preferred accommodations to facilitate advanced bookings at economical prices;
- Developing a quarterly expense forecast, in consultation with team members expected to undertake activities with reimbursable expenses;
- Clarifying desired frequency of monitoring meetings with the Client Task Team as well as the process for review of deliverables;
- Identifying opportunities to profile the results of Work Package 1, including submitting manuscripts to peer-reviewed journals and presenting at science conferences / symposia. The project budget does not account for this knowledge management activities but it is possible for ESSA to invest in these as professional development or business development.

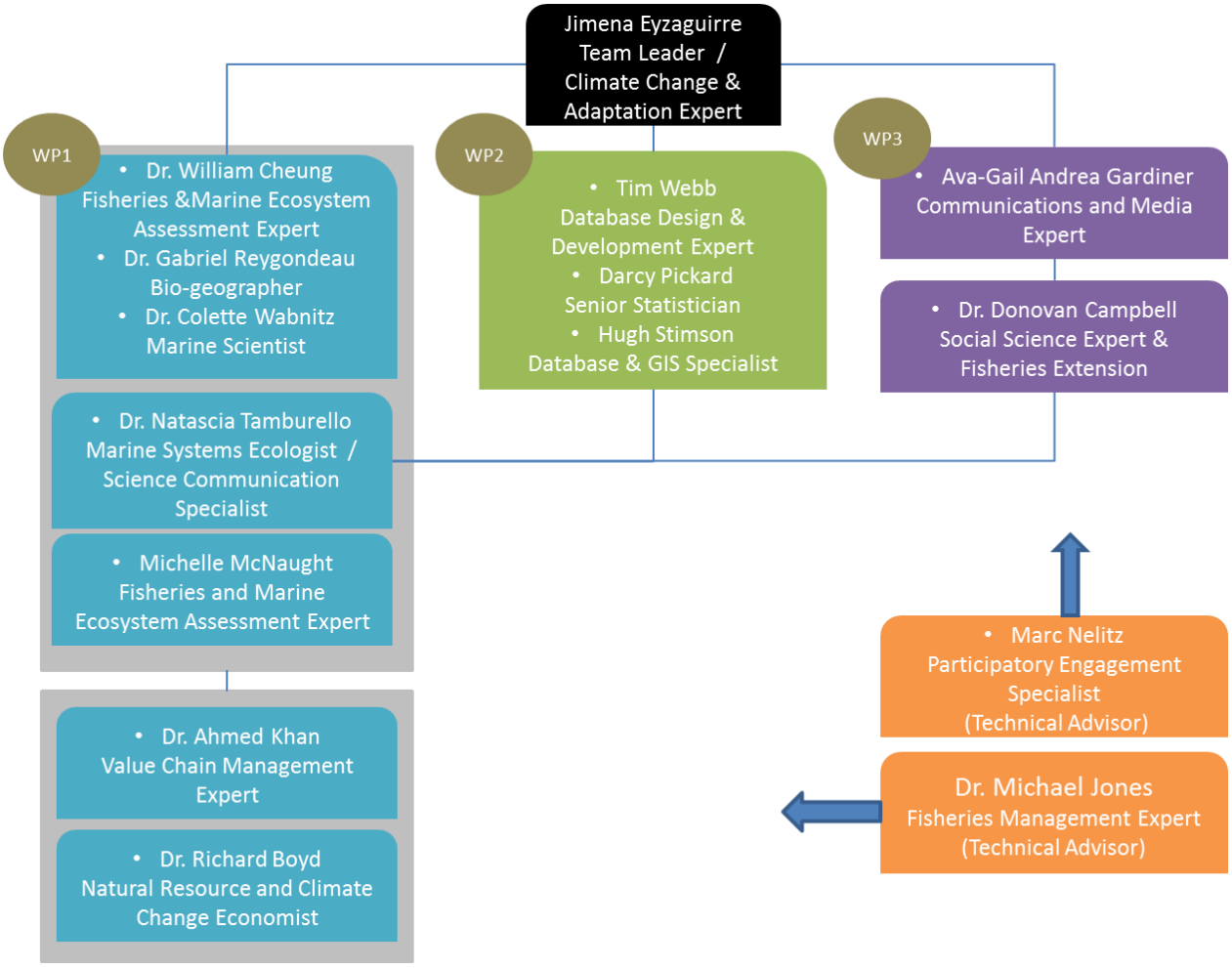

Figure 7: Organigram of the project team. Contributors to WP1 are split by focus on ecological / socio-economic assessment. Several team members will contribute to WP4, although activities in that Work Package will be led by the team leader. Technical Advisors will perform review functions and supply advice on specific project activities.

5.2 Project Risks

The table below highlights the risks / issues we consider most material. Monitoring their evolution will be important. For WP1 risks relate to data availability and relevance. For WP2 risks relate to relevance and

sustainability of project results. For WP3 risks relate to scope creep, expectations, access to people and budgetary constraints. For WP4 they relate to relevance and buy-in.

Identified risk or issue	Mitigation action
Lack of stakeholder buy-in for the project. Stakeholders range from representatives of PPCR countries to actors along the fish value chain	Establish a project committee early on so country representatives can have a voice in how the project is delivered. Ensure implementation roles are clear and cultivate them as champions. A robust and well-communicated research process and results provided in formats relevant to audiences will help ensure people are supportive of the data/evidence that is compiled as a point of departure for identifying feasible adaptation and DRM strategies and actions. Make the awareness-raising campaign engaging, combining analytical evidence with emotional appeals and artistic expression.
Getting good information in a timely manner for the socio-economic impact assessment & value chain analysis may be a challenge	Regionally-based project team members can help with follow up of data requests and planning of data collection missions. Early identification and engagement of agencies holding fisheries and socio-economic data to remind them of the project once the CRFM Client has announced it Become acquainted with the level of official communications needed and formats for follow up to data requests so that they yield results.
The databased and monitoring system gets little uptake once the project concludes	Understanding decision-making needs will be at the forefront right from initial meetings with stakeholders. We will develop options of different database approaches we could develop and identify "minimum viable products" with most potential for adoption, given capacities. Develop database solutions that can expand over time with improvements in types and quantity of data. Manage expectations in stakeholder interactions on what is possible to accomplish based on the best available information.
Slippage in project activities due to miscommunication or lack of coordination among the project team	The team will set up a WhatsApp group to streamline quick communications (e.g., requests for a meeting). Redundancies on the team. Compile a brief monthly progress report and use it to take stock on what's working and what would be improved.
Failure to secure participation in the training program by national representatives	Early engagement with candidates for training, emphasizing how they stand to benefit from participating, with messaging reinforced by the CRFM Client. Targeting two representatives from each PPCR instead of one has the potential to spread project benefits further and prevents losses in human capacity with staff turnover.
Failure to meet high expectations for behaviour change over the course of the project.	Behavior change is a long-term process. Given that this is a 2-year assignment (18 months will allow for the actual design and implementation of the campaign), reasonable parameters must be set for what can be achieved. That time frame is best to focus on awareness-raising as behavior change usually needs at least 2-3 years to sustainably note changes.

6. NEXT STEPS

This inception report outlines the Project Team's improved and refined understanding of this project. Continued and open communications on the evolution of objectives, activities, deliverables and timelines is important. So too is putting the necessary systems in place for successful implementation of project activities. For this reason, we outline next steps for consideration by the Client Task Team, in addition to listing next steps for us to take. Next steps for consideration by the Client Task Team:

- Provide critical feedback on this inception report, particularly as regards to our vision for the ecological impact assessment, plans for the Regional Planning Workshop and criteria for selection of pilot study sites.
- Clarify expectations on PPCR branding and communications.
- Advise on any additional content that may be necessary to notify PPCR countries of the project launch, Regional Planning Workshop and proposed activities leading up to it (situational assessments).
- Clarify whether CRFM technical staff (beyond Dr Singh-Renton) are interested / available to participate in project activities related to socio-economic assessment and under WP2. Dr Singh-Renton has already expressed an interest in undertaking analytical work for the ecological impact assessment.

Immediate next steps for the Project Team include the following:

- Finalize the agenda and materials needs for the Regional Planning Workshop.
- Develop options for pilot study sites based on consideration of criteria and implications for data collection (WP1-value chain analysis and WP3 – KAP study)
- Follow up with stakeholders to understand (1) implementation progress on the Regional Strategy and Plan of Action and (2) data needs and database management capacities to support fisheries and marine resource management

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APPENDIX 1 TO ANNEX II: DRAFT SPECIES LISTS FOR ECOLOGICAL IMPACT ASSESSMENT

Top Fisheries by Landings : Identified to Species	
Scientific Name	**Common Name**
Ablennes hians	Flat needlefish
Acanthocybium solandri	Wahoo
Auxis thazard	Frigate tuna
Caranx crysos	Blue runner
Caranx latus	Horseeye jack
Caranx ruber	Bar jack
Cephalopholis cruentata	Graysby
Cephalopholis fulva	Coney
Coryphaena hippurus	Common dolphinfish
Decapterus macarellus	Mackerel scad
Decapterus punctatus	Round scad
Elagatis bipinnulata	Rainbow runner
Epinephelus guttatus	Red hind
Epinephelus morio	Red grouper
Euthynnus alletteratus	Little tunny
Harengula clupeola	False herring
Hemiramphus brasiliensis	Ballyhoo halfbeak
Heteropriacanthus cruentatus	Glasseye
Holocentrus adscensionis	Squirrelfish
Istiophorus albicans	Atlantic sailfish
Katsuwonus pelamis	Skipjack tuna
Lobatus gigas	Queen conch
Lutjanus campechanus	Northern red snapper
Lutjanus purpureus	Southern red snapper
Makaira nigricans	Blue marlin
Mulloidichthys martinicus	Yellow goatfish
Ocyurus chrysurus	Yellowtail snapper
Opisthonema oglinum	Atlantic thread herring
Panulirus argus	Caribbean spiny lobster
Rhomboplites aurorubens	Vermilion snapper
Sarda sarda	Atlantic bonito
Scomberomorus brasiliensis	Serra Spanish mackerel
Scomberomorus cavalla	King mackerel
Scomberomorus regalis	Cero
Selar crumenophthalmus	Bigeye scad
Sparisoma aurofrenatum	Redband parrotfish
Sparisoma viride	Stoplight parrotfish
Sphyraena barracuda	Great barracuda
Thunnus alalunga	Albacore
Thunnus albacares	Yellowfin tuna
Thunnus atlanticus	Blackfin tuna
Thunnus obesus	Bigeye tuna
Tylosurus crocodilus	Hound needlefish
Xiphias gladius	Swordfish

Top Fisheries by Landings : Identified to Genus	
Scientific Name	**Common Name**
Acanthuridae	Surgeons, tangs, unicornfishes
Acanthurus	Surgeonfishes
Anguilliformes	Eels, morays
Balistidae	Triggerfishes
Calamus	Porgies
Carangidae	Jacks, pompanos
Carcharhinidae	Requiem sharks
Chaetodontidae	Butterflyfishes
Clupeidae	Herrings, sardines, menhadens
Dendrobranchiata	Shrimps and prawns
Epinephelus	Seabasses, hinds
Haemulidae	Grunts, sweetlips, bonnetmouths
Harengula	False herrings
Hemiramphidae	Halfbeaks, garfishes
Holocentridae	Squirrel-, soldierfishes
Istiophoridae	Billfishes
Labridae	Wrasses, gropers, tuskfishes
Lutjanidae	Snappers
Lutjanus	Snappers
Mugilidae	Mullets, grey mullets
Mullidae	Goatfishes
Muraenidae	Moray eels
Octopus	Octopuses, pikas
Panulirus	Spiny lobsters
Sciaenidae	Drums, croakers
Scomberomorus	Spanish mackerels
Scombridae	Mackerels, tunas, bonitos
Serranidae	Basses, groupers, hinds
Sphyraena	Barracudas, sennets
Thunnus	Tunas

Table A-1: Key fisheries organisms common to the lists of top 30 fisheries by landings across all fisheries sectors and pilot countries, including important components of the catch identified to either species or only the genus level. Data extracted from the Sea Around Us Project (SAUP) Global Fisheries Catch Reconstruction database, and top 30 lists for each individual pilot countries presented in Tables A-1 to A-7 above.

Country	Scientific Name	Common Name	Industrial (tonnes)	Artisanal (tonnes)	Subsistence (tonnes)	Recreational (tonnes)	Total Landings (tonnes)
Jamaica	*Carangidae*	Jacks, pompanos	3	15,858	384,262	0	400,124
Jamaica	*Sphyraenidae*	Barracudas	0	1,102	312,045	15	313,163
Jamaica	*Serranidae*	Basses, groupers, hinds	0	19,542	284,251	0	303,793
Jamaica	*Lutjanidae*	Snappers	850	24,013	278,409	0	303,273
Jamaica	*Haemulidae*	Grunts, sweetlips, bonnetmouths	2,719	27,946	163,731	0	194,396
Jamaica	*Lobatus gigas*	Queen conch	0	192,661	0	0	192,661
Jamaica	*Carcharhinidae*	Requiem sharks	0	0	142,343	0	142,343
Jamaica	*Holocentridae*	Squirrel-, soldierfishes	0	16,578	39,699	0	56,277
Jamaica	*Opisthonema oglinum*	Atlantic thread herring	69	46,194	0	0	46,263
Jamaica	*Mullidae*	Goatfishes	0	36,691	0	0	36,691
Jamaica	*Sparisoma viride*	Stoplight parrotfish	0	32,350	0	0	32,350
Jamaica	*Acanthurus*	Surgeonfishes	0	24,350	0	0	24,350
Jamaica	*Panulirus argus*	Caribbean spiny lobster	42	19,876	0	0	19,918
Jamaica	*Ocyurus chrysurus*	Yellowtail snapper	168	16,034	0	0	16,201
Jamaica	*Scombridae*	Mackerels, tunas, bonitos	585	4,277	9,907	0	14,769
Jamaica	*Epinephelus guttatus*	Red hind	0	14,190	0	0	14,190
Jamaica	*Caranx latus*	Horseeye jack	0	11,452	0	0	11,452
Jamaica	*Balistidae*	Triggerfishes	0	11,144	0	0	11,144
Jamaica	*Epinephelus morio*	Red grouper	10,915	0	0	0	10,915
Jamaica	*Caranx crysos*	Blue runner	0	10,589	0	0	10,589
Jamaica	*Thunnus albacares*	Yellowfin tuna	8,235	927	0	0	9,161
Jamaica	*Haemulon*	Grunts	0	8,140	0	0	8,140
Jamaica	*Xiphias gladius*	Swordfish	6,960	0	0	0	6,960
Jamaica	*Muraenidae*	Moray eels	0	0	6,677	0	6,677
Jamaica	*Mugilidae*	Mullets, grey mullets	0	5,819	0	0	5,819
Jamaica	*Coryphaena hippurus*	Common dolphinfish	45	4,182	0	0	4,227
Jamaica	*Cephalopholis fulva*	Coney	0	4,133	0	0	4,133
Jamaica	*Calamus*	Porgies	749	2,753	0	0	3,502
Jamaica	*Clupeidae*	Herrings, sardines, menhadens	0	2,431	0	0	2,431
Jamaica	*Sphyraena barracuda*	Great barracuda	0	2,205	0	0	2,205

: Top 30 species and species groups caught in Jamaican fisheries, sorted by total landings (tonnes) from 1950 to 2014 and broken down by fisheries sector. Data extracted from the Sea Around Us Project (SAUP) Global Fisheries Catch Reconstruction database.

Country	Scientific Name	Common Name	Industrial (tonnes)	Artisanal (tonnes)	Subsistence (tonnes)	Recreational (tonnes)	Total Landings (tonnes)
Haiti	*Labridae*	Wrasses, gropers, tuskfishes	0	108,046	78,502	0	186,548
Haiti	*Panulirus*	Spiny lobsters	0	46,288	36,871	0	83,159
Haiti	*Caranx ruber*	Bar jack	0	37,924	27,711	0	65,634
Haiti	*Dendrobranchiata*	Shrimps and prawns	4	29,214	23,293	0	52,511
Haiti	*Selar crumenophthalmus*	Bigeye scad	0	22,215	16,232	0	38,447
Haiti	*Sphyraenidae*	Barracudas	0	21,051	15,045	0	36,096
Haiti	*Mulloidichthys martinicus*	Yellow goatfish	0	11,901	8,696	0	20,597
Haiti	*Haemulidae*	Grunts, sweetlips, bonnetmouths	2,934	7,616	5,557	0	16,108
Haiti	*Haemulon*	Grunts	0	8,688	6,312	0	15,000
Haiti	*Sparisoma viride*	Stoplight parrotfish	0	8,410	6,145	0	14,555
Haiti	*Coryphaena hippurus*	Common dolphinfish	98	14,012	0	0	14,110
Haiti	*Makaira nigricans*	Blue marlin	39	14,012	0	0	14,050
Haiti	*Lutjanus campechanus*	Northern red snapper	0	8,092	5,913	0	14,006
Haiti	*Mullidae*	Goatfishes	0	7,299	5,339	0	12,639
Haiti	*Acanthocybium solandri*	Wahoo	211	10,509	0	0	10,719
Haiti	*Holocentrus adscensionis*	Squirrelfish	0	6,188	4,522	0	10,710
Haiti	*Scombridae*	Mackerels, tunas, bonitos	152	10,509	0	0	10,661
Haiti	*Thunnus*	Tunas	0	10,509	0	0	10,509
Haiti	*Sphyraena*	Barracudas, sennets	0	10,509	0	0	10,509
Haiti	*Holocentridae*	Squirrel-, soldierfishes	0	6,008	4,369	0	10,377
Haiti	*Heteropriacanthus cruentatus*	Glasseye	0	4,443	3,246	0	7,689
Haiti	*Decapterus macarellus*	Mackerel scad	0	4,284	3,130	0	7,415
Haiti	*Lutjanus purpureus*	Southern red snapper	6,975	0	0	0	6,975
Haiti	*Rhomboplites aurorubens*	Vermilion snapper	0	3,967	2,899	0	6,866
Haiti	*Tylosurus crocodilus*	Hound needlefish	0	3,015	2,203	0	5,218
Haiti	*Octopus*	Octopuses, pikas	0	2,251	2,900	0	5,151
Haiti	*Chaetodontidae*	Butterflyfishes	0	2,843	2,066	0	4,909
Haiti	*Cephalopholis cruentata*	Graysby	0	2,539	1,855	0	4,394
Haiti	*Ocyurus chrysurus*	Yellowtail snapper	207	2,063	1,507	0	3,777
Haiti	*Hemiramphus brasiliensis*	Ballyhoo halfbeak	0	1,904	1,391	0	3,295

Table A-3: Top 30 species and species groups caught in Haitian fisheries, sorted by total landings (tonnes) from 1950 to 2014 and broken down by fisheries sector. Data extracted from the Sea Around Us Project (SAUP) Global Fisheries Catch Reconstruction database.

Country	Scientific Name	Common Name	Industrial (tonnes)	Artisanal (tonnes)	Subsistence (tonnes)	Recreational (tonnes)	Total Landings (tonnes)
Dominica	*Hemiramphus brasiliensis*	Ballyhoo halfbeak	0	4,960	13,625	0	18,585
Dominica	*Coryphaena hippurus*	Common dolphinfish	1	4,555	4,667	0	9,223
Dominica	*Lutjanidae*	Snappers	86	2,791	5,232	0	8,109
Dominica	*Epinephelus*	Seabasses, hinds	1	2,519	4,658	0	7,179
Dominica	*Thunnus*	Tunas	0	1,094	3,507	0	4,602
Dominica	*Makaira nigricans*	Blue marlin	245	3,249	0	0	3,494
Dominica	*Holocentridae*	Squirrel-, soldierfishes	0	852	2,182	0	3,034
Dominica	*Balistidae*	Triggerfishes	0	959	2,063	0	3,022
Dominica	*Scombridae*	Mackerels, tunas, bonitos	63	41	2,850	0	2,954
Dominica	*Thunnus albacares*	Yellowfin tuna	705	1,913	0	0	2,618
Dominica	*Caranx*	Jacks	1	133	2,195	0	2,328
Dominica	*Haemulidae*	Grunts, sweetlips, bonnetmouths	552	294	1,084	0	1,929
Dominica	*Mullidae*	Goatfishes	0	497	1,296	0	1,793
Dominica	*Acanthocybium solandri*	Wahoo	67	1,440	0	0	1,507
Dominica	*Scomberomorus cavalla*	King mackerel	79	467	665	0	1,211
Dominica	*Katsuwonus pelamis*	Skipjack tuna	146	938	0	0	1,084
Dominica	*Thunnus atlanticus*	Blackfin tuna	140	894	0	0	1,034
Dominica	*Clupeidae*	Herrings, sardines, menhadens	0	5	1,000	0	1,006
Dominica	*Anguilliformes*	Eels, morays	0	290	693	0	983
Dominica	*Epinephelus morio*	Red grouper	540	0	0	0	540
Dominica	*Thunnus alalunga*	Albacore	395	0	0	0	395
Dominica	*Sarda sarda*	Atlantic bonito	48	247	0	0	296
Dominica	*Acanthuridae*	Surgeons, tangs, unicornfishes	0	115	97	0	212
Dominica	*Lutjanus purpureus*	Southern red snapper	168	0	0	0	168
Dominica	*Istiophorus albicans*	Atlantic sailfish	25	115	0	0	140
Dominica	*Carcharhinidae*	Requiem sharks	0	19	107	0	126
Dominica	*Calamus*	Porgies	96	0	0	0	96
Dominica	*Thunnus obesus*	Bigeye tuna	79	6	0	0	84
Dominica	*Auxis thazard*	Frigate tuna	49	0	0	0	49
Dominica	*Scomberomorus*	Spanish mackerels	40	0	0	0	40

Table A-4: Top 30 species and species groups caught in the fisheries of Dominica, sorted by total landings (tonnes) from 1950 to 2014 and broken down by fisheries sector. Data extracted from the Sea Around Us Project (SAUP) Global Fisheries Catch Reconstruction database.

Country	Scientific Name	Common Name	Industrial (tonnes)	Artisanal (tonnes)	Subsistence (tonnes)	Recreational (tonnes)	Total Landings (tonnes)
Saint Lucia	*Scombridae*	Mackerels, tunas, bonitos	8,413	15,658	0	0	24,072
Saint Lucia	*Coryphaena hippurus*	Common dolphinfish	5,391	9,965	0	23	15,380
Saint Lucia	*Carangidae*	Jacks, pompanos	120	4,224	9,495	31	13,870
Saint Lucia	*Lutjanidae*	Snappers	211	1,427	2,270	33	3,941
Saint Lucia	*Hemiramphidae*	Halfbeaks, garfishes	0	1,447	1,484	0	2,931
Saint Lucia	*Balistidae*	Triggerfishes	0	998	1,572	0	2,570
Saint Lucia	*Serranidae*	Basses, groupers, hinds	0	683	1,582	0	2,265
Saint Lucia	*Lobatus gigas*	Queen conch	0	1,138	831	0	1,969
Saint Lucia	*Holocentridae*	Squirrel-, soldierfishes	0	608	834	0	1,442
Saint Lucia	*Panulirus argus*	Caribbean spiny lobster	19	542	877	0	1,438
Saint Lucia	*Epinephelus morio*	Red grouper	1,225	0	0	0	1,225
Saint Lucia	*Sphyraenidae*	Barracudas	0	354	733	5	1,091
Saint Lucia	*Haemulidae*	Grunts, sweetlips, bonnetmouths	977	0	0	7	984
Saint Lucia	*Clupeidae*	Herrings, sardines, menhadens	0	498	407	0	905
Saint Lucia	*Thunnus albacares*	Yellowfin tuna	756	47	0	0	802
Saint Lucia	*Katsuwonus pelamis*	Skipjack tuna	681	70	0	0	750
Saint Lucia	*Acanthuridae*	Surgeons, tangs, unicornfishes	0	205	323	0	529
Saint Lucia	*Muraenidae*	Moray eels	0	193	298	0	491
Saint Lucia	*Acanthocybium solandri*	Wahoo	398	78	0	9	485
Saint Lucia	*Mullidae*	Goatfishes	0	269	166	0	434
Saint Lucia	*Lutjanus purpureus*	Southern red snapper	410	0	0	0	410
Saint Lucia	*Carcharhinidae*	Requiem sharks	10	267	114	0	392
Saint Lucia	*Istiophoridae*	Billfishes	1	369	0	5	374
Saint Lucia	*Scomberomorus cavalla*	King mackerel	291	0	0	42	333
Saint Lucia	*Labridae*	Wrasses, gropers, tuskfishes	0	75	74	0	148
Saint Lucia	*Sciaenidae*	Drums, croakers	0	65	72	7	144
Saint Lucia	*Istiophorus albicans*	Atlantic sailfish	113	2	0	0	114
Saint Lucia	*Euthynnus alletteratus*	Little tunny	112	0	0	0	112
Saint Lucia	*Makaira nigricans*	Blue marlin	56	56	0	0	111
Saint Lucia	*Scomberomorus regalis*	Cero	96	0	0	0	96

Table A-5: Top 30 species and species groups caught in Saint Lucian fisheries, sorted by total landings (tonnes) from 1950 to 2014 and broken down by fisheries sector. Data extracted from the Sea Around Us Project (SAUP) Global Fisheries Catch Reconstruction database.

Country	Scientific Name	Common Name	Industrial (tonnes)	Artisanal (tonnes)	Subsistence (tonnes)	Recreational (tonnes)	Total Landings (tonnes)
SVG	*Decapterus macarellus*	Mackerel scad	0	10,318	7,393	0	17,711
SVG	*Selar crumenophthalmus*	Bigeye scad	83	6,774	4,516	0	11,373
SVG	*Thunnus albacares*	Yellowfin tuna	9,325	0	0	0	9,325
SVG	*Epinephelus guttatus*	Red hind	2,567	3,654	2,130	0	8,351
SVG	*Panulirus argus*	Caribbean spiny lobster	335	3,965	1,885	0	6,186
SVG	*Cephalopholis fulva*	Coney	464	2,833	1,647	0	4,944
SVG	*Sparisoma aurofrenatum*	Redband parrotfish	4,462	0	0	0	4,462
SVG	*Thunnus atlanticus*	Blackfin tuna	4,231	14	0	0	4,245
SVG	*Coryphaena hippurus*	Common dolphinfish	646	3,150	0	6	3,802
SVG	*Lutjanus purpureus*	Southern red snapper	502	1,527	1,236	0	3,265
SVG	*Istiophorus albicans*	Atlantic sailfish	3,010	47	0	0	3,057
SVG	*Lobatus gigas*	Queen conch	308	1,843	753	0	2,904
SVG	*Haemulidae*	Grunts, sweetlips, bonnetmouths	2,233	148	45	2	2,428
SVG	*Hemiramphidae*	Halfbeaks, garfishes	469	1,713	0	0	2,182
SVG	*Lutjanidae*	Snappers	1,614	306	101	8	2,029
SVG	*Acanthocybium solandri*	Wahoo	652	1,119	0	2	1,772
SVG	*Decapterus punctatus*	Round scad	220	844	635	0	1,699
SVG	*Katsuwonus pelamis*	Skipjack tuna	1,443	0	0	0	1,443
SVG	*Elagatis bipinnulata*	Rainbow runner	722	452	191	0	1,365
SVG	*Harengula*	False herrings	0	581	459	0	1,040
SVG	*Makaira nigricans*	Blue marlin	978	47	0	0	1,024
SVG	*Acanthurus*	Surgeonfishes	1,009	6	2	0	1,016
SVG	*Lutjanus*	Snappers	0	675	211	0	886
SVG	*Thunnus alalunga*	Albacore	830	0	0	0	830
SVG	*Carangidae*	Jacks, pompanos	731	10	0	8	749
SVG	*Epinephelus morio*	Red grouper	724	0	0	0	724
SVG	*Xiphias gladius*	Swordfish	544	41	0	0	585
SVG	*Sphyraena barracuda*	Great barracuda	241	277	0	0	519
SVG	*Scomberomorus cavalla*	King mackerel	442	0	0	11	453
SVG	*Epinephelus*	Seabasses, hinds	16	297	105	5	423

Table A-6: Top 30 species and species groups caught in the fisheries of Saint Vincent & the Grenadines (SVG), sorted by total landings (tonnes) from 1950 to 2014 and broken down by fisheries sector. Data extracted from the Sea Around Us Project (SAUP) Global Fisheries Catch Reconstruction database.

Country	Scientific Name	Common Name	Industrial (tonnes)	Artisanal (tonnes)	Subsistence (tonnes)	Recreational (tonnes)	Total Landings (tonnes)
Grenada	*Selar crumenophthalmus*	Bigeye scad	0	9,859	6,076	0	15,935
Grenada	*Thunnus albacares*	Yellowfin tuna	661	14,602	0	0	15,262
Grenada	*Epinephelus guttatus*	Red hind	0	7,707	4,561	0	12,268
Grenada	*Decapterus punctatus*	Round scad	0	5,821	3,943	0	9,765
Grenada	*Thunnus atlanticus*	Blackfin tuna	200	7,728	0	0	7,928
Grenada	*Lutjanidae*	Snappers	86	4,584	2,898	6	7,575
Grenada	*Coryphaena hippurus*	Common dolphinfish	1,428	4,655	0	5	6,088
Grenada	*Istiophorus albicans*	Atlantic sailfish	269	3,945	0	0	4,214
Grenada	*Scomberomorus cavalla*	King mackerel	653	2,321	0	8	2,982
Grenada	*Serranidae*	Basses, groupers, hinds	0	1,416	912	0	2,328
Grenada	*Makaira nigricans*	Blue marlin	102	2,201	0	0	2,303
Grenada	*Hemiramphidae*	Halfbeaks, garfishes	0	1,267	894	0	2,161
Grenada	*Panulirus argus*	Caribbean spiny lobster	0	1,210	788	0	1,998
Grenada	*Harengula clupeola*	False herring	0	1,120	796	0	1,916
Grenada	*Carangidae*	Jacks, pompanos	0	1,069	775	6	1,851
Grenada	*Sphyraena barracuda*	Great barracuda	378	1,300	0	0	1,678
Grenada	*Lobatus gigas*	Queen conch	0	1,037	595	0	1,632
Grenada	*Clupeidae*	Herrings, sardines, menhadens	0	877	657	0	1,534
Grenada	*Ablennes hians*	Flat needlefish	0	883	642	0	1,525
Grenada	*Epinephelus morio*	Red grouper	1,521	0	0	0	1,521
Grenada	*Xiphias gladius*	Swordfish	29	1,331	0	0	1,360
Grenada	*Carcharhinidae*	Requiem sharks	201	1,155	0	0	1,356
Grenada	*Caranx latus*	Horseeye jack	0	761	447	0	1,208
Grenada	*Elagatis bipinnulata*	Rainbow runner	0	729	454	0	1,183
Grenada	*Cephalopholis fulva*	Coney	0	593	385	0	977
Grenada	*Sparisoma aurofrenatum*	Redband parrotfish	0	603	357	0	960
Grenada	*Haemulidae*	Grunts, sweetlips, bonnetmouths	684	44	28	1	758
Grenada	*Scomberomorus brasiliensis*	Serra Spanish mackerel	379	227	93	9	708
Grenada	*Katsuwonus pelamis*	Skipjack tuna	81	472	0	0	553
Grenada	*Lutjanus purpureus*	Southern red snapper	343	0	0	0	343

Table A-7: Top 30 species and species groups caught in the fisheries of Grenada, sorted by total landings (tonnes) from 1950 to 2014 and broken down by fisheries sector. Data extracted from the Sea Around Us Project (SAUP) Global Fisheries Catch Reconstruction database.

ANNEX III: REGIONAL PLANNING WORKSHOP REPORT

ABOUT THIS DOCUMENT

This is the report of the Regional Planning Workshop, marking the official launch of the Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System project. The project is an initiative under the Regional Track of the Caribbean Pilot Programme for Climate Resilience (PPCR), funded by the Climate Investment Funds through the Inter-American Development Bank (IDB), and managed by the University of the West Indies' Mona Office for Research and Innovation (MORI). The Regional Planning Workshop was held in Kingstown, St. Vincent and the Grenadines from April 25 to 26 2018.

Hosting of the Regional Planning Workshop was a joint effort of the consulting firm delivering the project, ESSA Technologies Ltd. (ESSA), and the Caribbean Regional Fisheries Mechanism (CRFM) Secretariat. Technical coordination and facilitation for the workshop was provided by Jimena Eyzaguirre, Team Leader, and the ESSA team. Dr. Susan Singh-Renton, Deputy Director CRFM Secretariat advised on the workshop objectives and agenda. Logistical support was provided by Pam Gibson, CRFM Secretariat. Participation of twelve delegates from the six Caribbean focal countries was made possible by the financial support of IDB and MORI (see Figure 1). This report contains a summary of the presentations, discussions and direction provided by stakeholders on project activities and implications for project scope.

Figure 1: Workshop participants. Back row, starting from the left: Anginette Murray (Jamaica, Fisheries Division), Ahmed Khan (ESSA Project Team), Moramade Blanc (Haiti, Fisheries Department), Allena Joseph (Saint Lucia, Fisheries Department), Susan Singh-Renton (CRFM Secretariat), Thaddeus Augustin (Castries Fishermen Co-operative Society Ltd.), Maxwell John (St. Vincent & the Grenadines, Rural Transformation, Industry and Labour), Ian Jones (Jamaica, Fisheries Division). Front row, starting from the right: Shamal Connell (St. Vincent & the Grenadines, Fisheries Division), Ava-Gail Gardiner (ESSA Project Team), Royan Isaac (Grenville FAD Fishers Organization Inc.), Jimena Eyzaguirre (ESSA), Natascia Tamburello (ESSA), Tim Webb (ESSA), Crofton Isaac (Grenada, Fisheries Division), William Cheung (ESSA Project Team), Jullan DeFoe (Dominica, Fisheries Division), Roger Charles (Haiti, Fisheries Department), Hudson Toussaint (Dominica, Fisher)

PURPOSE AND OVERVIEW OF WORKSHOP PROCEEDINGS

This section summarizes the workshop proceedings, highlighting the topics covered, participants' reactions to these topics and any decisions made (i.e., what happened during the workshop). To maintain high levels of engagement, the workshop design incorporated presentations and participatory exercises, with agenda items mixing technical aspects and project governance.

Day 1

Introduction, participant expectations and project overview

The Regional Planning Workshop (the workshop) of the *Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System* project (the project) was held in Kingstown, St. Vincent and the Grenadines, 25 to 26 April 2018. The workshop brought together 12 representatives from the six countries with national Pilot Programme on Climate Resilience (PPCR) initiatives, the Caribbean Regional Fisheries Mechanism (CRFM) secretariat and members of the consulting team delivering the project to help build relationships between the project team and regional stakeholders and ensure effective integration of stakeholder perspectives and knowledge into project research and engagement activities.

Executed by the Mona Office for Research and Innovation (MORI) at the University of West Indies at Mona, Jamaica, and with the CRFM as the co-implementer and service beneficiary, the project aims to *improve availability and use of information for "climate-smart" planning and management in the fisheries and aquaculture sector in the Caribbean*. The project is part of the Investment Plan for the Caribbean Regional Track of the PPCR. Although the project is of regional relevance, it consists of six participating countries, which are the direct beneficiaries - Jamaica, Haiti, Dominica, Saint Lucia, Grenada and St. Vincent and the Grenadines.

Project planning began in January 2018. The workshop marked the first opportunity for stakeholder engagement and for eliciting input to scope discrete project activities. The objectives of the workshop were to:

- Develop a shared understanding of the pathways of climate change impact on ecological and socio-economic components of two fisheries systems (reef, mangrove / seagrass and pelagic ecosystems)
- Clarify the purpose and functions of a climate-smart fisheries monitoring system and related fisheries and environment database
- Discuss options and select pilot study sites for local project activities and eventual implementation of the monitoring system that could best serve the intended functions**
- Strengthen communication goals around knowledge, awareness and practice on climate adaptation and disaster risk reduction responses within the Caribbean fisheries sector
- Establish a CRFM PPCR Project Working Group

***Due to time constraints we deferred the discussion on pilot study sites to a future meeting / online discussion.*

The workshop was co-hosted by the CRFM Secretariat (Kingstown) and ESSA Technologies Ltd. (ESSA), the consulting firm delivering the project, with technical facilitation provided by members of the ESSA team. Aside from the CRFM Secretariat, participants comprised 12 representatives from Jamaica, Haiti, Dominica, Saint Lucia, Grenada and St. Vincent and the Grenadines, both fisheries managers and fisherfolk. The complete list of participants is in Appendix 1; the workshop agenda is in Appendix 2.

The workshop started with participant introductions and brief reflections on expectations of the workshop. Instead of confining comments to expectations for the workshop participants spoke broadly about expectations (and challenges) for the project and their roles as a result. Table 1 below captures participants' expectations in their own words. Themes include the need to and importance of building climate resilience; organizational shifts required to mainstream adaptation; the need for user-friendly tools and models that

prove sustainable and stand up to scrutiny; the importance of sharing information with fishers on how climate change will affect them; and an interest in exploring practical solutions, policy instruments and alternative livelihood strategies to deal with climate change impacts in the sector.

	**Dominica:** Coming from a country that has seen major hurricane devastation, including some 60% loss of fishing assets, we want to become more climate resilient, and other countries need to do so too. This will be a new phase for many public officers - to play a role in mainstreaming climate change adaptation.
	**Grenada:** I'm sincerely hoping that the tools and models can somehow help us to overcome the horrors that we have in preparing projects for the Green Climate Fund and when you have to justify adaptation measures as NOT being development. What I hope we achieve is to enhance my knowledge of the ecological impacts of climate change on our fisheries system. Because climate change does affect what I do (fishing) on a daily basis. When I get back, I hope to share with my organization what I've learned. What I realize is a lot of fishers in my area need to do more to enhance knowledge about climate change, a lot of them don't know how climate change affects them on a daily basis.
	**Haiti:** I would like to be able to collect sufficient tools that can help us to improve fisheries management in our country. In my country, we have very basic data, if we get more tools we can collect more on fisheries industry and climate change, and get more people and residents involved and informed, including civilians and private sector. We have the expectation that [the project can help] communities living in coastal zones to become more resilient.
	**Jamaica:** What I want to see is at the end how we can pull all these components and disciplines together and the sustainability of this project after the completion of this project, hoping to get something lasting considering all our data limitations, needs, and wants, and that the models we present are credible and can stand up to scrutiny in the end. I would like to see what are the policy instruments that can assist our small-scale fishers in Jamaica? What could be presented as alternative livelihood options?
	**St. Lucia:** I want to be able to get new information and contribute. Fishermen often get left behind in climate change conversation, and I want them to understand how it affects them and take this information back to them to help do that. I'd like to gain a better appreciation of tools that will help improve climate change impact assessment. Tools that are more efficient and consider our constraints, and are user friendly. Often times we learn about a model but then when we go home can't easily incorporate it into decision-making. The challenge is implementing these instruments and keeping them sustainable.
	**St. Vincent and the Grenadines:** I'd like to see ways in which fishers can better respond or adapt to the impacts of climate change and how we can be more resilient. I'd like us to come up with some detailed and practical solutions that could be implemented and lead to active results.

Table 1: Participant expectations of the workshop and the project overall

Dr. Susan Singh-Renton, Deputy Executive Director at the CRFM Secretariat, provided opening remarks. She mentioned that this project was the second marine-focused activity of the Caribbean Regional Track PPCR and highlighted other CRFM tools and studies available to inform the sector's adaptation to climate change (including insurance instruments, a marine climate change report card and a new early warning system, FEWER, Fisheries Early Warning Emergency Response system app). Dr. Singh Renton emphasized their approach of addressing the issue at all levels as part of a holistic strategy to fisheries management and the need for real and practical solutions. She stressed the importance of sharing with the consulting team the challenges seen "on the ground" to develop clever and practical solutions to these problems.

The ESSA team leader, Ms. Jimena Eyzaguirre, provided an overview of the project objectives, the four work packages (assessment; climate-smart fisheries monitoring system; stakeholder engagement and communications; and integration of climate risk and resilience into regional fisheries development and planning) and expected outputs from each. Before sharing the definition of "climate-smart fisheries" provided by the UN Food and Agricultural Organisation (FAO), she elicited thoughts from participants. Ideas included (a) overcoming the impacts of climate change, from harvesters to processors to higher economic interactions; (b) positioning the sector to take advantage of climate change impacts (e.g., if increased sea surface temperatures lead to reduced catch then implement value-added approaches to increase the value of smaller pool of product; (c) adding value across the value chain to adapt to ecological and socio-economic impacts of climate change. The FAO definition comprises strengthening resilience to climate change and variability (to both long term changes and disaster risks), sustainably increasing productivity and income and reducing sector's greenhouse gas contributions, with ecosystems-based management approaches feeding into being "climate smart".

There was some discussion on ways to maximize the value of the project. According to the ESSA consulting team, measures of success for the project include (1) a high level of meaningful consultation with stakeholders from the 6 PPCR countries; (2) project outputs that are nationally-relevant with potential for regional applicability and (3) a high potential for sustainability of results in the absence of CRFM support. Susan suggested creating a D-Group (virtual collaborative space) to enable regular interaction from participants throughout the working process. We parked this suggestion for discussion later in the day. Participants expressed an interest in cultivating policymakers' understanding of the level of effort involved in undertaking ecological and socio-economic impact studies, such as the ones carried out as part of the project.

<u>Ecological modelling used in the project</u>

Dr. William Cheung, the ESSA team's Fisheries & Marine Ecosystem Assessment Expert, gave a presentation on the ecological modelling approach the team is using to assess regional climate change impacts. He started by providing an overview of observed and projected changes of increasing global greenhouse gas emissions on ocean-atmosphere environments. Direct impacts (increased sea surface temperature – SSTs, decreased oxygen levels and increased ocean acidity) affect marine ecosystems, fisheries and our society. Changes in temperature and other ocean conditions affect the biology of the organisms and affect population level dynamics such as growth, abundance and distribution. This will then affect assemblages and community structure, which then affects fisheries through changes in species composition of catch, or maximum catch potential and the economics of fishing. Ultimately, all of these changes will interact with other global issues such as population growth, migration, development and global food supply dynamics. Ocean warming is driving changes in species composition, including local extinctions, invasions into other areas where ocean temperature falls within their tolerance limits and increase in abundance. Offshore fish can shift 100s of km per decade, bottom fish 10s of km per decade, very bottom fish 3-4 km per decade. "Blue fish" (cold-water fish) shift north and to greater depths, away from the countries of interest. The mean temperature of catch (metric used to track the impact of SST on

fish composition) in the Caribbean has increased, based on trend analysis 1970-2010.[4] The bigger the reef area the smaller the change in mean temperature of catch, which stresses the importance of maintaining healthy reefs.

Participants asked about influences of SSTs on fish biology and about changes in ocean currents. William explained that beyond influence of SST on species distributions, there are other aspects of biology that SST influences, e.g., there are observations of reducing body sizes and earlier age / smaller size of maturity in dolphinfish in St. Lucia. This has also been observed for conch in Jamaica. A participant noted that, locally, changes in ocean currents are being observed: strong tides / currents used to happen two to three days per month but now they happen continuously for months at a time. Changing currents really affect fishers' day to day activities (fuel, safety and volume of catch), especially those targeting bottom fishing because they cannot operate under these conditions.

Regional ecological modelling in this project employs an integrated framework (see Figure 2) to understand the projected rate of species invasion, local extinction, species turnover as well as changes in maximum catch potential (for the region and by up to 50 focal species) by 2050 and 2100 for two scenarios of global greenhouse gas concentration pathways so-called "representative concentration pathways" (RCP 2.6 and RCP 8.5). The modelling will provide indicators of exposure of ecological impacts to fisheries in each of the six countries of focus. William ended the presentation by explaining limitations to the modelling, which add uncertainty to the results. The analytical framework does not consider evolutionary adaptation or fisheries management scenarios. In addition, trophic interactions are not explicitly represented. Finally, the resolution of earth system model projections is coarse, with implications for interpreting results for smaller nations and interlinked fishing zones.

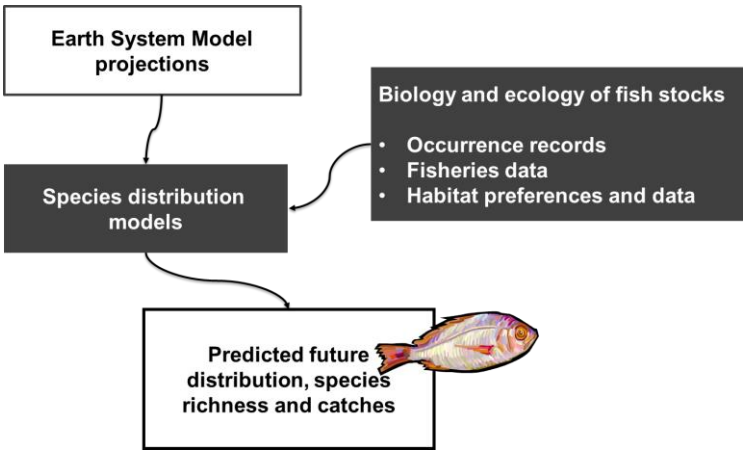


Figure 2: Ecological modelling framework (simplified)

The question and answer session following the presentation revealed the following issues of interest to participants:

- Whether the model incorporates fish size - The model does take this into account. William has published papers asserting that warming would theoretically reduce body size, even though they mature earlier. This research projects a 20 to 30% decrease in body size worldwide by mid-century. Change in average / maximum body size over time can be an indicator for each species modelled.

[4] Mean temperature of catch (MTC) is an index to track distributional shifts of marine fishes and invertebrates in response to ocean warming. It is calculated from the average inferred temperature preference of exploited species weighted by their annual catch. See: https://www.nature.com/articles/nature12156

- The types of fish movement represented - The model does consider movement, but specific regional migration patterns of whole populations are not explicitly considered (e.g., regional seasonal migration of tunas).
- The main factors driving species distributions and abundance – William clarified that temperature always shows up as a major driver. For pelagic species, ocean productivity is the next major driver and in coastal areas it's habitat availability (e.g., reefs, mangrove).
- Confidence in modelling outputs - Confidence level depends on the scale. At the global level, tropical areas tend to have the highest confidence, especially in the direction of change. In general, multiple models agree in tropical areas. But there is more uncertainty associated with finer-scale projections. Our approach relies on our current understanding of climate change impacts on oceanography. It's important to be clear about the usefulness of finer-scale projections: they are more of a guide for adaptation planning than "the answer".
- Consideration of fisheries management scenarios - Management impacts could be greater than those of climate change so it's important to account for this somehow. Dr Cheung suggested looking in the possibility of incorporating simple management scenarios (e.g., low, medium, overfishing) to overlay on the baseline modelling outputs.
- Consideration of the invasion of sargassum mats affecting species sizes and composition - The modelling framework can possibly accommodate the movement of sargassum over a large area by incorporating sargassum as a habitat layer into the model. However, this is challenging because movement is highly dependent on advection (currents).
- How modelling results can inform decisions - Modelling results can help countries prepare their fisheries for changes, including new species and fisheries opportunities for some northern Caribbean countries, transition to offshore fisheries for countries with larger continental shelves to both follow movement of fish species and to encourage people to fish away from coastal zones to remove pressure on reefs, and the potential need for equitable regional sharing of shifting catches. As a specific example, model outputs can be useful in discussing in what contexts or where FADs might be a useful adaptation measure.
- Importance of incorporating fish species with a range of thermal tolerance in the modelling - It's important to be strategic about the list of focal species to focus on in the modelling; the list should incorporate species that are already in the region that seem to be becoming more important; it should incorporate a complement of fish species that cover a range of thermal tolerances.

William led workshop attendees through a participatory conceptual modelling exercise. The objective of creating conceptual models of the impacts of climate change on key ecosystems was to develop a picture of the participants' understanding and perceptions of the key components, processes and linkages within ecosystems and the pathways through which climate change might affect them. The exercise focused on two marine ecosystems: the pelagic ecosystem and the seagrass-mangrove-coral reef ecosystem. Conceptual models for the two ecosystems were derived in parallel. William facilitated the exercise for the pelagic ecosystem while Dr. Natascia Tamburello, ESSA team's Marine Systems Ecologist, facilitated the one for the seagrass-mangrove-coral reef ecosystem. An effort was made to ensure each conceptual model integrated views from representatives from the 6 PPCR countries. The conceptual modelling by each sub-group proceeded in the following steps:

- Step 1: Bound the systems of interest. Participants decided that conceptual models should encompass the upper < 200 m depth of the ocean within countries' exclusive economic zones (pelagic ecosystems) and the coastal habitat complexes of seagrass beds, mangrove forests and coral reefs (seagrass-mangrove-coral reef ecosystem) of the six focal countries.

- Step 2: Identify key biophysical components of ecosystems and interactions among components. Each participant wrote the five key components s/he felt best represented the biophysical part of the ecosystem on individual post-it notes. Examples included fishes, their growth and reproduction,

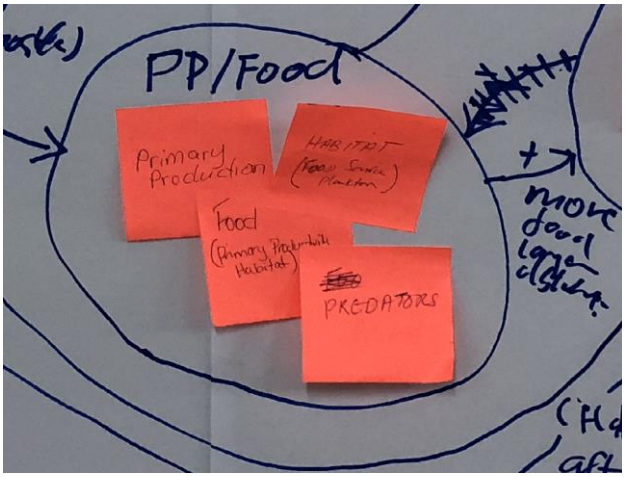
habitats etc. The identified components were then put on the wall to share with other participants. The facilitator (William or Natascia) clustered similar individual contributions in up to six key biophysical components of the ecosystem. For example, “primary production”, “food”, “habitat as a food source platform” and “predators” were clustered into a primary production / food component. Participants then identified the connections among components, indicating the direction and nature of these linkages (e.g., positive or negative effects, and why the components were linked).

- Step 3: Identify the main climate change-related drivers (e.g., increase in SST) affecting the biophysical components of the ecosystems. Individual participants first wrote on post-it notes their perception of the main environmental factors. Then, facilitators guided discussions to identify and note the environmental drivers of most concern to the group. The participants then drew the linkages between these environmental drivers and the key biophysical components of the ecosystem and how each component would be affected.

- Step 4: Identify the human components perceived as being affected by and affecting the key biophysical components of the ecosystems (e.g., harvesting regulations). Similar to previous activities, participants individually wrote ideas on human components, the facilitator guided a discussion for participants to share their ideas and then the group agreed on a consolidated set of human elements. They then identified the linkages between the human and biophysical components of the individual ecosystems.

- Step 5: Rank all linkages among components of the pelagic and mangrove-seagrass-coral reef ecosystems by their perceived importance. Each participant was given 10 ‘votes’, with each vote represented by a dot sticker. Participants cast their votes by placing the stickers on the linkages shown on the conceptual map. Linkages with greater numbers of stickers (votes) ranked higher in importance relative to linkages with fewer stickers.

The developed conceptual models of the two ecosystems were then shared with all workshop participants (Figure 3).


PP/Food
Primary Production
Food
PREDATORS

A


Temperature
Physical habitat
Current pattern
Extreme weather events
Chemical pollution

B


FISHERIES MANAGERS + ENFORCEMENT
MPA MANAGERS + STAFF
Reduction
FISHERS
DEMERSAL FISHERS
Fishers
→ Artisanal
→ Industry
FISH PROCESSORS
CONSUMERS
RESTAURANTERS
FISH EXPORTERS
Vector of Introduction
(Indy inv. seagrass on anchors)
eutrophication
ANIMALS
NUISANCE SPECIES
Predation
spills
PREDATORS
HERBIVORES
PLANKTON
Fish stock
Invasive Species
AQUACULTURE

C


Habitat
ANIMALS
Pollution
O3 depletion
Dredging
BIOPHYSICAL HABITAT
WATER CHEMISTRY
pH
HOUSEHOLD CHEMICALS
MARINE TRAFFIC

D

E

Figure 3: Photos highlighting the conceptual modelling exercise. Panel A illustrates clustering of individual ideas on key biophysical components. Panel B shows how environmental drivers, in this case climate drivers only, were layered onto the key biophysical components identified in the previous step. The blue sticky notes in Panel C illustrate participants' ideas on key human components and their relationship to biophysical components. Panel D shows a participant "voting" on the linkages among components of most importance. Panel E shows a participant presenting the developed conceptual model to all the workshop participants.

Terms of reference for a project Working Group

Jimena reviewed draft terms of reference (ToRs) for the creation of a CRFM PPCR Fishery Assessment and Monitoring Study Working Group ("the working group"). Comprising fisheries management representatives from each of the 6 PPCR countries as well as the CRFM Secretariat, the intended purpose of this working group is to facilitate two-way interaction between the ESSA consulting team and national representatives to ensure the relevance of project outputs and operational support to maximize the efficiency of project implementation. Jimena reviewed the proposed objectives, roles (consulting team, CRFM Secretariat and member countries), modalities of operation, obligations and responsibilities of members and membership provisions and engaged participants in a question and answer session. Participants provided the following general and specific feedback on the draft ToRs.

- Use the working group as a vehicle for one-on-one interactions, to resolve some of the issues that are country-specific.
- Country members will include a delegate and an alternate. A fisheries officer from each country should be represented. Nominees can include people not present at this Regional Planning Workshop.
- Country members (delegates and alternates) will not be responsible for answering all the questions or attending to all issues that arise through the working group. Different work packages require different expertise. However, country members should have an overarching perspective on all the critical stakeholders and act as "connectors", linking the ESSA consulting team to required stakeholders and experts in country.
- Recognizing competing demands on country members' time and the importance of staying engaged and maintaining that commitment, it was suggested that the ToRs include an indicative level of

effort (e.g., hours / month) that can be expected and a meeting calendar driven by project deliverables and milestones.

- Try to avoid a big gap in communications, send regular updates and products. Meeting once a quarter would not be sufficient to maintain momentum. Some form of interaction on a monthly basis or so would be more adequate.

The proposal received overall support and, thus, a working group will be established, guided by ToRs updated to reflect this feedback (see updated ToRs in Appendix 3).

Hopes and concerns for the project

As a final activity of the day, Jimena invited participants to reflect and share reflections on hopes and concerns for the project and its results. The following table (Table 2) provides highlights of the feedback received.

Hopes relate to access to new information and monitoring and management approaches that were more inclusive. Concerns relate to ensuring project outputs are credible, salient and based on the best available scientific information and to sustainability of project results. Political will to take up recommendations stemming from the project is a concern shared by many as is the ESSA project team's ability to recommend tools and methods that respond to differential capacities and realities across the region.

Hopes	Concerns
Potential to measure impacts of climate change in terms of revenue and other quantitative metrics Better policy instruments Successes despite limited resources and capacity in each country Possibility for "pre-conditioning", laying the ground work to anticipate constraints to implementation of recommendations Monitoring systems and management tools that are inclusive, allowing for greater level of participation from fishers and community members	Theoretical and not very practical solutions Oversimplified models Not being able to access relevant quality data to create credible assessments; data must be reliable and validated Political will for implementation of recommendations stemming from the project, including investments in monitoring and improved management Excluding policymakers in technical project discussions increases odds of messages getting lost in translation; not enough support to interpret results/ final products Ability to recommend tools and methods that can be sustained with existing resources or generate enough interest and excitement to justify incremental investments

Table 2: Participants' hopes and concerns for the project

Day 2

Socio-economic analysis approaches used in the project

Dr. Ahmed Khan, ESSA's team's Value Chain Management Expert, opened the day's proceedings by providing an overview of socio-economic analysis approaches used in the project, with a focus on *value chain analysis*.

Ahmed first provided a primer on value chains. Value chains are a research approach that has emerged to address socio-economic and livelihood vulnerabilities.[5] The approach is especially applicable to fisheries,

[5] Gudmunsson et al. 2006. Revenue generation through the seafood value chain. FAO Circular # 1019. FAO, Rome.

as seafood is highly perishable with higher levels of post-harvest spoilage than other agri-commodities.[6] Seafood is the most tradable commodity in the world, as such, attention to product quality, processing methods and health standards can enhance revenues. Further, product differentiation can contribute to various consumer preferences and market niches.[7] These business and livelihood opportunities can lead to greater market share and enhance the contribution of seafood to food security, foreign earnings and coastal livelihoods. However, governing fisheries for value addition is challenging and requires coordination among stakeholders with different frames (e.g., fish as a valued species or a commodity)[8], not to mention the need to contend with both climate and non-climate factors affecting the resource base.[9]

Through the value chain approach, we are investigating the level of exposure and sensitivity to both climatic and non-climatic drivers of change and to identify management measures that support climate change adaptation and resilience building. Conceptually, the value chain provides an analytical framework to understand seafood production from marine ecosystems (pre-harvest) to the capture (fishing) and post-harvest stages (processing and marketing). Analyses across the value chain can be quantitative in terms of fishing revenue, cost allocation, and profit margins[10]; in addition to price mark-up across seafood actors[11], as well as conceptual, facilitating a visual display of flows of products and distribution outlets.[12]

Value chain research will involve a series of semi-structured interviews with three target groups: managers and administrators; resource users and fishing livelihoods; and post-harvest actors. Understanding climate risk and current and potential policy responses is a cross-cutting line of enquiry of the primary research. The types of policy responses and interventions contemplated include regional stocks agreements, policy integration (e.g., mainstreaming adaptation in integrated coastal zone management), hard and soft coastal interventions, private-public partnerships for risk transfer, fiscal incentives and inclusive policy instruments, fisher cooperatives as catalyst for change for stewardship & eco-branding and harnessing NGOs as policy brokers.

The question and answer session following the presentation on the value chain analysis primer revealed the following issues of interest to participants:

- Generational differences - The generational divide that exists among fishers and related mindsets and ways of doing business, for example regarding safety at sea and business risk management practices is a challenge but also an opportunity. According to one participant *"it will be hard to get through to some of the older fishermen; it'll be harder to change their system because they're set in their ways"*. Training new young fishers in modern and sustainable techniques, technologies, and safety and supporting their entry into the industry with proper certification, education, and business skills could be an opportunity to capitalize on seafood as the #1 globally-traded commodity.
- The optimal length of the value chain - In most islands, consumers can go straight to a landing site to buy fish directly from harvesters. Some fish already attract their optimal price (e.g., dolphinfish) and the price difference across landed species is minimal so the benefits of additional processing are not apparent unless there's a shift in consumer preferences. Dr Khan explained that the value chain can be controlled by fishers (if many and organized) or consumers (if fishers not organized) and we are trying to understand how systems work here.

Gereffi et al. 2005. The governance of global value chains. Review of International Political Economy 12:78-104

[6] FAO 2016. State of World Fisheries and Aquaculture. FAO, Rome.

[7] Jaffry et al. 2004. Consumer choices for quality and sustainability labeled seafood products in the UK. *Food Policy*, 29: 215-228

[8] Bavinck et al. 2007. Interactive Fisheries Governance. MARE, University of Amsterdam.

[9] Miller et al. 2012. Climate change, uncertainty, and resilient fisheries: Institutional responses through integrative science. *Progress in Oceanography*, 87(1-4): 338-346.

[10] Gudmunsson et al. 2006. Revenue generation through the seafood value chain. FAO Circular # 1019. FAO, Rome.

[11] Purcell et al. 2017. Distribution of economic returns in SSF for international markets: A value chain analyses. *Marine Policy*, 86:9-16.

[12] Khan 2010. Understanding global supply chains and seafood markets for the rebuilding prospects of Northern Gulf Cod Fisheries. *Sustainability*, 4(11): 2946-2969.

- The role of cooperatives in building resilience of the sector. Fisheries cooperatives differ across the region. In Dominica most cooperatives were formed out of necessity for the purpose of attracting or receiving government aid, but are not self-sustaining. Cooperatives continue to exist only with heavy support from the fisheries ministries and managers. The model in Saint Lucia is different. Most of the fishing cooperatives also own gas stations so fishers have a backup source of income and can also use that for their own boat fuel. In Saint Lucia the cooperatives are regulated by government and enshrined in the law.
- The regional and local relevance of ITQs and quotas. Instruments that work in Australia and Japan, South Pacific and elsewhere, may not work or translate to the Caribbean due to lack of capacity. Dr Khan asserted that these are just options we are investigating.

Aside from value chain analysis the ESSA team will undertake socio-economic assessment of the impacts of climate change on land-based assets and inputs to the fisheries sector. Dr Richard Boyd, the ESSA team's Climate Change Economist, is leading this work. The regional planning workshop provided an opportunity to elicit input from local experts on the potential socio-economic impacts of climate change and climate and weather extreme events on a conceptual model of a typical fisheries sector, which is generalizable to the six PPCR countries.

Jimena and Natascia facilitated two parallel sessions, guiding workshop participants through an exercise to develop conceptual models that identify potential socioeconomic impacts of climate change and climate and weather extreme events on the fisheries sector. The exercise was performed for the same two fisheries as in the ecosystem modelling on Day 1: mangrove-seagrass-coral reef fisheries and pelagic fisheries.

For each fishery—which defined the system of interest—participants in the two groups were instructed to:

- Identify key activities and interactions / linkages between key activities;
- Identify key inputs to each activity (e.g., supporting infrastructure, assets, equipment, variable inputs and human resources);
- Characterize the main first-order physical impacts of specific climate changes or extreme weather events (e.g., loss and damage to infrastructure from tropical storms, hurricanes);
- Trace out the main second-order (cascading) impacts and ultimate economic and social consequences (e.g., temporary or permanent business closures resulting in unemployment, reduced net income etc.); and
- Determine priority impact pathways (i.e., those first- and second-order impacts resulting in the consequences of greatest concern for the sector). Due to time constraints we did not reach this step.

In the time available, participants developed models for two important climate stimuli: (1) changes in SST; and (2) storms (with compound hazards, such as strong winds, intense precipitation, storm surge). Time did not permit consideration of sea-level rise (SLR), which will have implications for coastal infrastructure that supports fishing. The developed conceptual maps are in Figure 4.

Figure 4: Photos highlighting the conceptual modelling exercise pertaining to socio-economic model of the impacts of climate change on the fisheries sector. Upper left panel: participant presenting the results of mangrove-seagrass-coral reef fisheries exercise to all participants; upper right panel: facilitator assisting clustering of ideas to represent on the pelagic fisheries conceptual map. Lower left panel: final participatory conceptual map of the seagrass-mangrove-coral reef fisheries sector; lower right panel: final participatory conceptual map of the pelagic fisheries sector.

<u>Defining a climate-smart fisheries monitoring system</u>

Mr. Tim Webb, the ESSA team's Database Design and Development Expert, led a discussion to help characterize a "climate smart fisheries monitoring system", starting with a brief presentation that emphasized the importance of collaboration between the ESSA consulting team, member countries and the CRFM Secretariat so the recommendations stemming from the work are sustainable and supportive of long-term monitoring. Tim started by explaining the range of purposes monitoring systems could serve: to fill gaps in existing data to reduce uncertainty; to provide data to support future assessments of climate vulnerabilities and impacts; to develop and refine policy and management decisions to improve climate resilience; and, to support the development of guidance and tools to incorporate climate change effects into existing fisheries management practices. He also reviewed the basic components of a monitoring system (indicators, sampling design, field and analysis protocols, analytical tools and models, data storage and dissemination), expected outputs from this project and implementation options for the monitoring system, including ways to build on existing regional monitoring programs.

Workshop participants provided feedback on the monitoring system through the use of worksheets (see Appendix 4) and a round table discussion. Lines of inquiry included: what should be monitored? What are existing national and regional tools and databases that could be leveraged? What implementation options are preferable? What are the training and staffing needs to support long term use of project outputs? National representatives worked in pairs to complete a worksheet and shared a few highlights of their responses in plenary.

In the workshop, participants were asked to highlight what would be useful to monitor given their knowledge of the situations in their countries plus the draft conceptual models produced in earlier sessions. Most indicators shared in plenary focused on monitoring key attributes of the entire fisheries system (biological and socioeconomic) both to understand the current status but also to detect changes over time due to climate change and other factors. Several participants noted funding and human resource capacity constraints to support adequate fishery monitoring, data collection, and data management systems. Workshop participants' comments suggested a preference for tools for use internally within their fisheries departments rather than regional/shared systems. Further analysis and implications of participants' written feedback appears in Section 4 of this report.

Identifying top-10 fish species

Dr. Cheung sought additional feedback from participants to help scope the ecological modelling work. He asked participants to identify the 10 species or species groups they thought of as most important to the fisheries in their countries. We provided participants with a table listing the top 50 species or species groups with the highest catch in the 2000s period based on the *Sea Around Us* catch database (www.seaaroundus.org). Representatives from each country then identified the top 10 species/species groups or listed species they should be included but were not listed. We also asked them to identify whether a species or species group was important commercially, for subsistence purposes, or both. Results of this priority-setting exercise appear in Section 2 of this report.

Strategic communications on fisheries climate adaptation and disaster risk reduction

The primary purpose of the communications and engagement component of this project is to find effective ways to transfer knowledge about the effects of climate change on the fisheries sector in the Caribbean and to identify promising climate resilience strategies, using the appropriate tools and decision aids to prompt reflection and action at multiple levels.

Communications objectives for the regional planning workshop were as follows: (1) to help participants to communicate the implications of climate change to the public, to policymakers, and to other stakeholders in the sector whose work and or livelihood will be affected by climate change; and (2) To draw on participants' knowledge as industry experts to identify the key messages that need to be communicated around climate change and fisheries, to clearly identify the target audiences, and to determine the approaches we can use (through this Project) to reach them most effectively.

The workshop, thus, provided Ms. Ava-Gail Gardener, the ESSA teams' Communications and Media Expert, the opportunity to interact directly with other team members and fisheries professionals/ practitioners from the six project countries to gain a more in depth understanding of the critical issues with a view to designing the project communication and engagement strategy. During the two days, Ava-Gail interviewed at least one representative from each country. These interviews helped gain knowledge of the fisheries sector in each country, source input for the workshop press release (see Appendix 5) and provide ideas on communications and media strategies for the project. The two-day immersion highlighted relevant local knowledge and perspectives, user needs and perceptions as well as some of the challenges of communicating complex issues and scientific evidence around climate change as it pertains to Caribbean fisheries.

The first draft of a Knowledge Attitudes Practice (KAP) survey was shared with the participants via an online link before the workshop. Sharing the draft KAP survey with workshop participants had the dual purpose of (a) testing the relevance and ease of interpretation of survey questions and (b) obtaining early feedback on communications messages and formats. The KAP study is a first output of the stakeholder engagement and communications work package. It is a key tool to ensure that communications and engagement activities are responsive to real needs, so considerable care is being taken in how it is designed and administered. Ten (10) of Thirteen (13) participants completed the survey. The team is using participant

responses to refine the KAP survey for government specialists / management audiences. The team will also modify the KAP survey to produce instruments for other target audiences.

On Day 2 Ava-Gail led a session on strategically communicating climate change in the fisheries sector. She began with a presentation on message development, where she reviewed the definition of communications and key tenets of communication (transmission and reception; target audience; and, substance and form). Ava-Gail then asked participants to briefly share their experiences on communicating climate change by encouraging them to answer the following questions: Why should he/she as a fisheries sector expert/ practitioner communicate about climate change? With whom should I communicate about climate change? How should I communicate about climate change to be most effective? Answers to these questions clarified the roles participants play as intermediaries in the information / knowledge chain and the priority audiences that the project should consider for communications and engagement activities. Ava-Gail emphasized that the communications approach is determined by the audience: language, pitch, medium, format and intensity are all factors to be considered.

Ava-Gail then led an exercise to brainstorm climate change messages. Participants were asked to divide into small groups (4-5 persons), and to (1) choose a target audience; (2) choose a main climate change related issue/ problem; and (3) develop a message specifically for this target audience that addresses this issue/ problem. Once groups finished, a representative from each shared their results (see Table 3) with the broader group. Ava-Gail provided constructive feedback on the messages crafted and concluded the session by thanking participants for their active engagement in this session and in interviews with her. Feedback at this stage is critically important to shape project activities.

Group 1	Group 2	Group 3
Target audience: Youth Problem: Too much Sargassum and how to harvest it in a sustainable and beach-friendly way. Message: "Make the mess your message: keep the shoreline keep the business".	Target audience: Youth Problem: Too much Sargassum Raise awareness and encourage action through a beach cleanup event.	Target audience: Fisherfolk Problem: Storm surges Message: "Attention fishers and boat-owners, please secure your boats immediately. A storm surge is expected in less than 24 hours, expect a weather bulletin soon" Small fishing vessels: "Haul inland as far as possible"; large fishing vessels: "Move to sheltered areas (e.g., mangrove)" Medium: Public service announcement (town crier with a bull horn)
Target audience: Policymakers Problem: Too much Sargassum Message: "A nation that is healthy is wealthy. Keep us healthy and wealthy, and we'll keep you!"		Target audience: General public Problem: Storm surges Message: "People living in flood prone areas are asked to evacuate immediately." Medium: Radio

Table 3: Results of brainstorming session on communications messages and strategies

Closing

Jimena closed the two-day workshop by thanking participants for their insights and ideas and listing action items for the next month. These include: sharing workshop materials with participants, organizing a virtual meeting to discuss a proposal for three pilot study sites for local research and engagement activities and reporting back on scoping implications of the regional planning workshop. The following sections of this

report analyze the feedback received during the workshop and describe new insights and direction of activities based on stakeholder feedback and learning by the ESSA team.

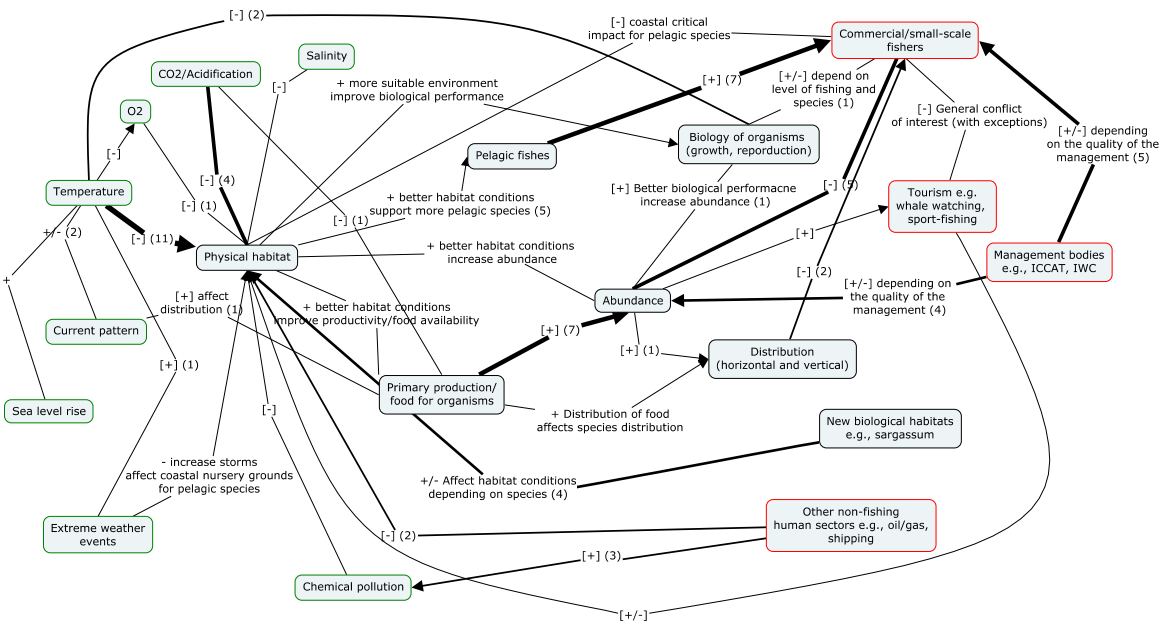
2. ECOLOGICAL ASSESSMENT

Authored by Dr. William Cheung, Dr Colette Wabnitz and Dr Gabriel Reygondeau, this section discusses scoping implications of the workshop on activities to model the ecological impacts of climate change on marine ecosystems in the Caribbean (Work Package 1).

Conceptual modelling of key ecosystems

Following the workshop, the ESSA team digitized the draft conceptual maps of the two ecosystems using the software Cmaptool (https://cmap.ihmc.us/). Cmaptool provides a graphical representation of the conceptual maps (Figure 5). Overall, we found that the perceived pathways of climate impacts were more direct for the pelagic ecosystem relative to the seagrass-mangrove-coral reef ecosystem.

A



B

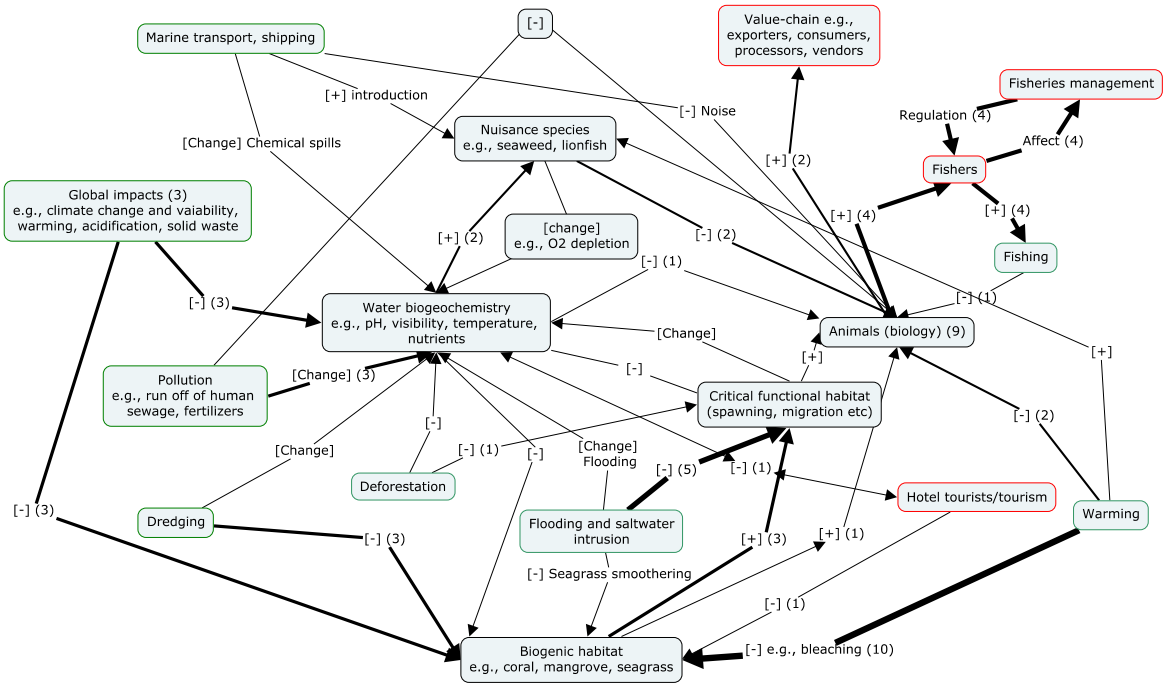


Figure 5: Conceptual models of the (A) pelagic ecosystem and (B) seagrass-mangrove-coral reef ecosystem visualized using Cmaptool. Boxes represent the biophysical components (black outline), environmental drivers (green outline) and human components (red outline) of the ecosystems. The arrows represent linkages and the nature of their impact ([+]: positive influence, [-]: negative influence). The number on each arrow represents the vote count of their importance. The thickness of the arrows is positively related to the number of votes to highlight the most important linkages.

For the pelagic ecosystem, ocean warming and acidification were the perceived main climate pathways affecting habitat conditions, which would in turn alter primary production and suitability of the habitat for pelagic fish stocks (Figure 5 A). These factors would then affect the abundance and distribution of pelagic fishes and their catches by fishers. The performance of fisheries management was also identified as an important modifier of fish abundance and catches. Participants raised the increased occurrence of Sargassum in the pelagic ecosystem as a factor that might positively or negatively affect fish habitats.

For the seagrass-mangrove-coral reef ecosystem, climate impact pathways were perceived to interact more strongly with other non-climatic marine and terrestrial drivers (Figure 5 B). Participants identified ocean warming as the main climate impact pathway that would affect biogenic habitats (e.g., loss of live coral cover through coral bleaching), with subsequent consequences for fishes that depend on these habitats, in turn impacting fisheries. These climate impacts were perceived to add to existing ecosystem threats posed by other non-climatic human drivers including pollution, dredging, and flood and seawater intrusion. Similar to the conceptual model of the pelagic ecosystem, fisheries management was identified as an important determinant of fish abundance and catches. The potential linkages between the pelagic and the seagrass-mangrove-coral reef systems were brought up during the plenary discussion e.g., through the potential climate effects on Sargassum. However, such linkages were not formally incorporated in the conceptual models.

Based on the findings from the conceptual modelling activities, the project team identified three main directions for subsequent modelling exercises:

- The conceptual models confirm that the use of habitat suitability models to elucidate the impacts of climate change on marine ecosystems and fisheries is appropriate. The main climate-impact

pathways perceived by the participants were through changes in the habitat quality that then affect fish stocks and fisheries. Such impact pathways, in general, can be explicitly represented through the habitat suitability modelling to be conducted as part of the ecological assessment for this project

- Fisheries management was identified as an important factor to consider in understanding the consequences of climate change on marine ecosystems and fisheries. Thus, we suggest including a set of simple, idealized alternative fishing scenarios in the study (e.g., underfishing, overfishing and sustainable fishing) to elucidate the potential interactions between climate change and fishing intensity on fish stocks.
- Sargassum was raised in the conceptual modelling exercise and the subsequent discussions as an important uncertainty in potential climate-related impacts on the ecosystems. Therefore, we suggest including a case study to assess the potential role of Sargassum in climate change impacts in the region. The assessment will be based on a review of the literature and informed by the biodiversity and modelling datasets that the ecological assessment team has at hand. Key questions that would be addressed are as follows: was there a change in occurrence/abundance of Sargassum in the area? If so, was the change due to climate change? How would occurrence of Sargassum change in the future under climate change? What are their observed and projected ecosystem impacts?

Priority species for ecological modelling

Overall, based on participants' inputs, we identified 30 species/species groups ranked as the top 10 most important species in the region (Table 4). These include species (fish as well as invertebrates) associated with pelagic and seagrass-mangrove-coral reef ecosystems. A few groups include multiple species (e.g., Carangidae, snappers). In subsequent follow-up meetings, we will solicit further inputs from experts to determine whether the main species belonging to these groups are already included in our priority list, and whether any new species should be included to represent the main species of these groups.

#	Scientific name	Common name	Ecosystem	Invertebrates/fishes
1	*Acanthocybium solandri*	Wahoo	Pelagic	Fishes
2	*Acanthuridae*	Surgeons, tangs, unicornfishes	S-M-CR	Fishes
3	*Carangidae*	Jacks, pompanos	Pelagic/S-M-CR	Fishes
4	*Caranx*	Jacks	Pelagic	Fishes
5	*Coryphaena hippurus*	Common dolphinfish	Pelagic	Fishes
6	*Decapterus macarellus*	Mackerel scad	Pelagic	Fishes
7	*Decapterus punctatus*	Round scad	Pelagic	Fishes
8	*Dendrobranchiata*	Shrimps and prawns	S-M-CR	Invertebrates
9	*Epinephelus guttatus*	Red hind	S-M-CR	Fishes
10	*Haemulon*	Grunts	S-M-CR	Fishes
11	*Hemiramphus brasiliensis*	Ballyhoo halfbeak	Pelagic	Fishes
12	*Istiophorus albicans*	Atlantic sailfish	Pelagic	Fishes
13	*Katsuwonus pelamis*	Skipjack tuna	Pelagic	Fishes
14	*Labridae*	Wrasses, gropers, tuskfishes	S-M-CR	Fishes
15	*Lobatus gigas*	Queen conch	S-M-CR	Invertebrates
16	*Lutjanidae*	Snappers	S-M-CR	Fishes
17	*Makaira nigricans*	Blue marlin	Pelagic	Fishes
18	*Mulloidichthys martinicus*	Yellow goatfish	S-M-CR	Fishes

19	*Ocyurus chrysurus*	Yellowtail snapper	S-M-CR	Fishes
20	*Opisthonema oglinum*	Atlantic thread herring	S-M-CR	Fishes
21	*Panulirus argus*	Caribbean spiny lobster	S-M-CR	Invertebrates
22	*Scomberomorus cavalla*	King mackerel	Pelagic	Fishes
23	*Scombridae*	Mackerels, tunas, bonitos	Pelagic	Fishes
24	*Serranidae*	Basses, groupers, hinds	S-M-CR	Fishes
25	*Sparisoma viride*	Stoplight parrotfish	S-M-CR	Fishes
26	*Thunnus*	Tunas	Pelagic	Fishes
27	*Thunnus alalunga*	Albacore	Pelagic	Fishes
28	*Thunnus albacares*	Yellowfin tuna	Pelagic	Fishes
29	*Thunnus obesus*	Bigeye tuna	Pelagic	Fishes

Table 4: 30 species/species groups ranked as the top 10 most important species by the workshop participants

A suggestion raised during the workshop by the participants was to check the temperature preferences and tolerances of the priority species. The purpose of such exercise would be to consider species with a range of temperature preferences and both stenothermal (only able to tolerate a small temperature range) and eurythermal (able to tolerate a wide temperature range) species. Subsequently, after the workshop, we consulted the University of British Columbia's Changing Ocean Research Unit database of species occurrence records and inferred mean thermal niches and the breadth of thermal niches (Figure 13). We found that the priority species that we identified include species with a mean temperature niche from 20 to 29˚C and breadth of their thermal niche that ranges from a few degrees Celsius to 20˚C. Thus, we consider that the priority species we have identified as in scope for the ecological modelling include species with a range of potential sensitivity to ocean warming (i.e., some species have a narrow range whereas others are more adaptable).

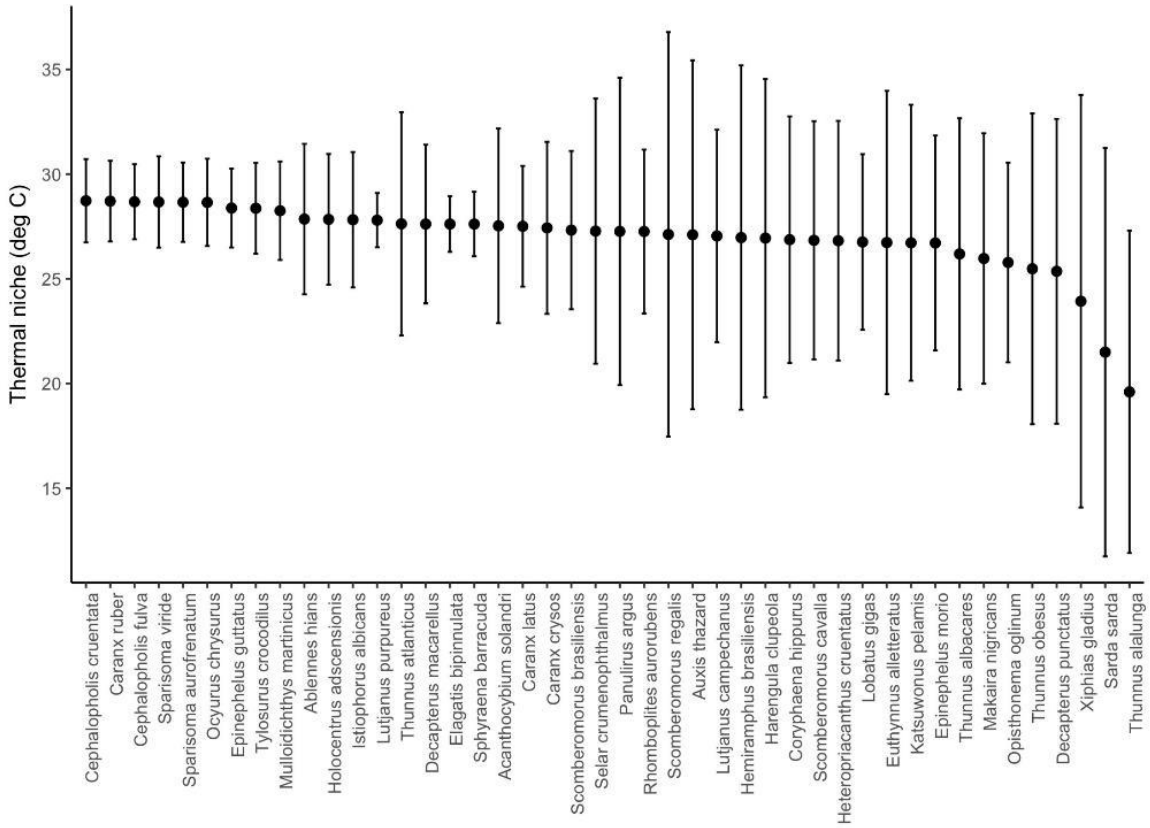


Figure 6: The mean thermal niche (black dots) and the breadth of the thermal niche (vertical lines) of the selected priority species.

3. VALUE CHAIN ANALYSIS AND SOCIO-ECONOMIC IMPACT ASSESSMENT

Authored by Dr. Ahmed Khan and Dr Richard Boyd, this section discusses emerging findings in characterizing fish value chains in the region and scoping implications of the workshop on activities to assess socio-economic impacts on the fisheries sector (Work Package 1).

Value chain analysis

In addition to Dr. Ahmed Khan's introduction to value chain analysis during the regional planning workshop, the meeting in Kingstown was an opportunity to pilot test a data collection instrument for value chain analysis. The questionnaire design sought to examine climatic risks and production options across the entire fish chain (pre-harvest, harvest, and post-harvest) and from the perspective of various stakeholder groups. The methodology draws from scholarship on the resilience of socio-ecological systems[13] and covers the following themes:

[13] Ostrom 2007. A General framework for analyzing sustainability of social-ecological systems. Science 325: 419-422.

Khan 2010. Understanding global supply chains and seafood markets for the rebuilding prospects of Northern Gulf Cod Fisheries. Sustainability, 4(11): 2946-2969.

Khan et al. 2016. Place-based or sector-based adaptation? A Case study of municipal and fishery policy integration. Climate Policy. DOI: 10.1080/14693062.2016.1228520.

Khan et al 2018. An Integrated Social-ecological Assessment of Ecosystem Service Benefits. Reg Environ Change. DOI: 10.1007/s10113-018-1356-0.

Coastal & marine governance (managers, planners and public administrators)

- Organizational and institutional vision on synergies between fisheries management, coastal disaster risk reduction, and climate adaptation planning
- Cross sectoral linkages on adaptation and fisheries co-benefits and spatial planning
- Mainstreaming adaptation into fisheries management
- Policy networks and brokerage across the fish chain

Resource users and fishing households (fishers, cooperatives and others)

- Resource use and fishing activities
- Livelihood vulnerability to climate stressors
- Cost and earnings of fishing fleets and techno-economic performance under climatic and non-climatic scenarios
- Individual, private and public adaptation responses to climate stressors

Post-harvest activities (processors, buyers, exporters, retailers, hotels, etc.)

- Product differentiation (fresh, whole, fillet, frozen, canned, smoked, etc.)
- Value addition and up-scaling initiatives (eco-labels, branding, traceability, etc.)
- Supply chain dynamics among stakeholders and supply chain risk
- Market destinations and consumer preferences

Thanks to the support from the CRFM Secretariat and national fisheries representatives, Ahmed was able to pilot and deploy the data collection instrument, completing 15 interviews and two focus-group discussions. Interviews can take over one hour to complete, therefore, participation in these interviews is a non-trivial investment in time by stakeholders. The following paragraphs provide highlights on emerging findings from literature reviews and data collection in Kingstown.

Pre-Harvest Stage

Researchers and regional agencies are active in understanding the impacts of climate change on fisheries and seafood production and options for climate resilience as evident by regional, national, and local initiatives as well as documentation on loss and damage from hurricanes and natural disasters.[14] Much work has been done at the regional level, through CARICOM and its advisory units such as CCCCC, CDEMA, and CRFM. Several scientific assessments have been completed[15] and projects and programs implemented.[16]. The UNDP/GEF project[17] on the Caribbean large marine ecosystems (CLME+), for instance, is uniquely poised to support climate resilience and nurture policy support for change. Other initiatives focused on climate services and early warning systems have been helpful in boosting emergency response capacity and in crowdsourcing data and citizen science for community resilience. New initiatives are underway to respond to socio-economic vulnerabilities through training on seafood quality standards, disaster readiness and attempts to increase access to risk transfer instruments.[18,]

A recent survey on fishing operations and the perception of fishers on important fish stocks yielded valuable information on fish stocks to assess and monitor. In this survey, fishers identified large and small pelagics, demersal species, shellfisheries, snapper, and dolphinfish as crucial to their livelihoods. It is, therefore,

[14] GIZ 2017. Loss and damage in the Caribbean: Climate change realities in Small Island Developing States. A study commissioned by the Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage). GTZ, Bonn and Eschborn.

[15] McConney et al. 2016. Disaster risk management and climate change adaptation in the CARICOM and wider Caribbean region – Strategy and action plan. FAO. Rome.

[16] CRFM 2013. Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture in the CARICOM Region. Volume 2 – Regional Strategy and Action Plan. CRFM Technical & Advisory Document, No. 2013 / 8. 29 p.

[17] CLME+ https://www.clmeproject.org/

[18] CRFM 2018. Model Disaster Management Plan for the Fisheries and Aquaculture sector of CRFM Member States. CRFM Technical & Advisory Document, No. 2013 / 8. 29 p

CCRIF, 2011. A Natural Catastrophe Risk Insurance Mechanism for the Caribbean – A collection of papers, articles and expert notes, Vol 2.

important to monitor the health of the following stocks and use this monitoring information to adjust management: spiny lobster (*Panulirus argus*), dolphinfish (*Coryphaena hippurus*), marlin (*Makaira nigricans*), wahoo (*Acanthocybium solandri*), yellowfin tuna (*Thunnus albacares*) and snapper (*Lutjanus sp; Etilis sp*).[19]

In St. Vincent and the Grenadines, the Fisheries Division oversees fisheries policy through various input and output control measures, provides support to fishers for compliance and stewardship, protected areas and marine conservation and by-catch control. Fisheries and coastal resources are two of twelve priority sectors of the National Adaptation Plan (NAP, within the global climate change framework). However, mainstreaming adaptation into fisheries management is a challenge owing to restrictions of top-down management and siloes between fisheries and coastal resources and adaptation. Enabling policy integration between fisheries, adaptation and disaster risk reduction means supplementing traditional fisheries management approaches encoded in the Code of Conduct for Responsible Fisheries with cross-sectoral collaboration with departments charged with planning, finance and sustainable development.

Harvest Stage

Fisheries management goals and objectives are encoded through the Fisheries Division and various legislative frameworks such as the Maritime Act (1983), Fisheries Act (1986) and Regulation (1987), the High Seas Fishing Act (2001), and the Town and Country Act. The goal is to "*improve the physical infrastructure, build resilience to climate change, and ensure the sustainable development of the fisheries resources while improving fisheries contribution to the national economy*."

Fish landings are dependent on the health of marine ecosystems, with stressors including Sargassum incursions, shifts in stock migration patterns and seasonality, bad weather, operational costs and market drivers do influence the volume and landed value. Fishers rely on this raw material supply as a commodity for their livelihood, for food, and as a way of life and culture. Fishing is seasonal and thus depends on regulations that dictate what is caught, how it is caught, how much, and by species. The majority of the catch landed on a national level is large and small pelagics (>80%). Deep sea fishing mostly for dolphinfish, yellowfin tuna, skip jacks and king fish as well as lobsters and conchs also takes place. According to FAO statistics, catch has been consistent since the early 2000s at about 806, 230 Kg harvested per year.

Fishers employ various types of boats, ranging from small to medium and large with crew sizes ranging from 2-3, 3- 5 and 3-15. Gear types include lines, nets and seines targeting multitude of fish species. Most of the catch is for sale and sold fresh. A small amount is often kept for household consumption (2-5%). Per capita seafood consumption has been constant at 18kg.

Almost all of the fishers interviewed are full time occupants in the industry except for one young crew member who also works as a mechanic (n=10). Some fishers started in other occupations (service or agriculture) but switched to fishing mostly due to the independence and daily wage as compared to salaried occupations. For most full-time fishers, fishing supplies 100% of their monthly household income and can range from $500 EC (Eastern Caribbean Dollar) on bad days to $7,000 EC during a good harvest season. Fishing operations can be daily or multi-day involving a couple of hours (where fish aggregating devices, FADs, exist), a day long trip to unplanned fishing grounds, and overnight trips from two to five nights.

The cost of fishing can be high, especially for the cost of buying a small boat of about 26 feet ($ 25,000 EC), an engine ($ 15,000 EC) and nets; daily operational costs include food, bait, gas, and repairs. Most fishers finance their fishing operations through family and relatives (mostly young fishers); others have had loans from cooperatives and community banks such as the Teachers and Police Co-operative Credit Unions.

[19] FAO & CRFM 2017. Impact of rising cost factors in fishing operations in CRFM Member States. Policy Brief No. 5.

Most of the fishers interviewed are content with their monthly and annual returns and would not change occupation for any reason or retrain to pursue other professions. This highlights a high level of vulnerability in the event of stock migration and lower total allowable catches. In the event of loss of income, most fishers rely on their meagre savings, kinship ties, as well as cooperative schemes. Government support through the National Insurance System is an option some young fishers are exploring. Membership in cooperatives is not widespread, because of the leadership and administrative challenges, but the few that are part of a cooperative (e.g., Goodwill Coop) pay their dues, get representation and explore collective bargaining opportunities. FADs were identified as one of the best ways to adapt to changing climate as it attracts various stocks thereby boosting catch, reducing time at sea and operational costs (especially fuel consumption).

Post-Harvest Stage

St. Vincent and the Grenadines is a net seafood importer, with national contribution to gross domestic product (GDP) reported at 0.4%. Seafood trade is mostly within regional markets (St Lucia and Martinique) as well as with the United States and Canada. Imported seafood includes salted cod, shrimp and salmon. The post-harvest stage of the fish chain in this country is, therefore, short with limited value addition opportunities and product differentiation. There are some 36 landing sites and about half of them in St. Vincent; due to limited storage and processing facilities in other landing sites most of the catch is taken to the Kingstown Fish Market. The Kingstown Fish Market is a great hub for landing fish and reporting catch statistics.

Value chain actors include the fisher, vendor or buyer, primary processor, secondary processor, exporter and consumer (Figure 7). The chain is not linear, as some seafood is directly sold from fishers to hotels or restaurants or to exporters, especially for shellfish such as lobsters and conch. About 80-90% of the catch harvested goes through vendors with limited value addition and high level of post-harvest spoilage. The 10-20% that goes through the Fish Market is sold frozen, often filleted according to retail needs and in the form of weekly supplies to supermarket chains focusing on larger pelagics such as swordfish, barracuda, skip jack and snapper. Skip jack can fetch $6 to 7 EC / pound to a vendor who will clean it, fillet it and sell it to local consumers for $9 EC per pound. Dolphinfish will be sold for $8 EC to a vendor but if cleaned and filleted by fisher can fetch from $10-12 EC to hotels and restaurants. At high end restaurants, grilled fish can compete with steak for the $40 to 50 EC range. A lobster dinner is typically a minimum of EC$65.

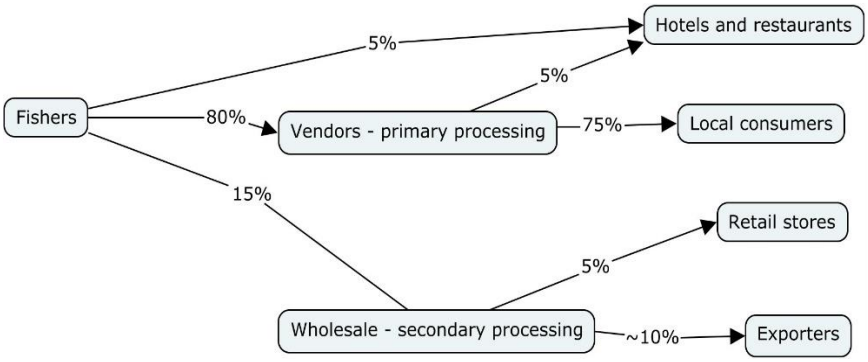


Figure 7: Schematic flow of average annual seafood by volume across the value chain (St Vincent and the Grenadines)

Vendors who also do primary processing do better in terms of total revenue than vendors who sub contract the cleaning and filleting. After expenses (e.g., stall fees) monthly earnings can range from $1,000 to $6,000 EC. The value chain was described as highly disconnected and fragmented with high level of operational and market risks. Both fishers and vendors identified opportunities for coordination and collective action especially through vertical integration linked to the new fisheries fleet policy or through self-organization of fishers and processors into cooperatives. This could help address power asymmetries and fairness along

the fish chain through policy brokerage and negotiation on key issues such as price setting, seasonality, storage facilities and access to finance. The level of risks and investment costs for fishers and vendors differ, with the operational cost for fishers varying greatly. Of note, after processing into fillet, about half of the fish is discarded. This provides an opportunity to further process discards into fish meal or aquaculture, bait, or as pet food.

Access to key inputs and services such as engines, baits, repairs, gas, etc. affect fishing operations as well as operational costs. These concerns do not get reflected in prices, as sale price by pound is fixed irrespective of the quality and nature of operational and variable costs. Exploring price-setting options that act as incentives for seafood quality standards and to address market risks is necessary. Options can be explored through a marketing board, price setting panel, or a joint association of fishers and processors that can negotiate price floor or ceilings with food safety standards to be met as an incentive for upscaling.

Concluding Remarks

Emerging understanding of the value chain and of coping measures currently taken in response to shocks is shedding light on potential policy gaps, new resource-sharing instruments, the role of cross-sectoral initiatives related to fiscal incentives and insurance, among others. More field work is required in other local sites to get a holistic and eclectic view of the nature of seafood value chains, level of social-ecological coupling, and to seek entry points to livelihood resilience to climate variability and climate change at the community, national and regional levels.

Socio-economic impact assessment

Conceptual socio-economic impacts and pathways models

Outputs from the workshop were subsequently synthesized by the project team and converted to Microsoft PowerPoint, resulting in the two models presented in Figure 8. The conceptual impact model for mangrove-sea grass-reef fisheries is shown in Panel A; Panel B provides the conceptual impact model for pelagic fisheries. Both climate stimuli (increased SSTs and storms - with compound hazards, such as strong winds, intense precipitation and storm surge) produce similar cascading impacts and consequences; hence, they are presented together for each fishery.

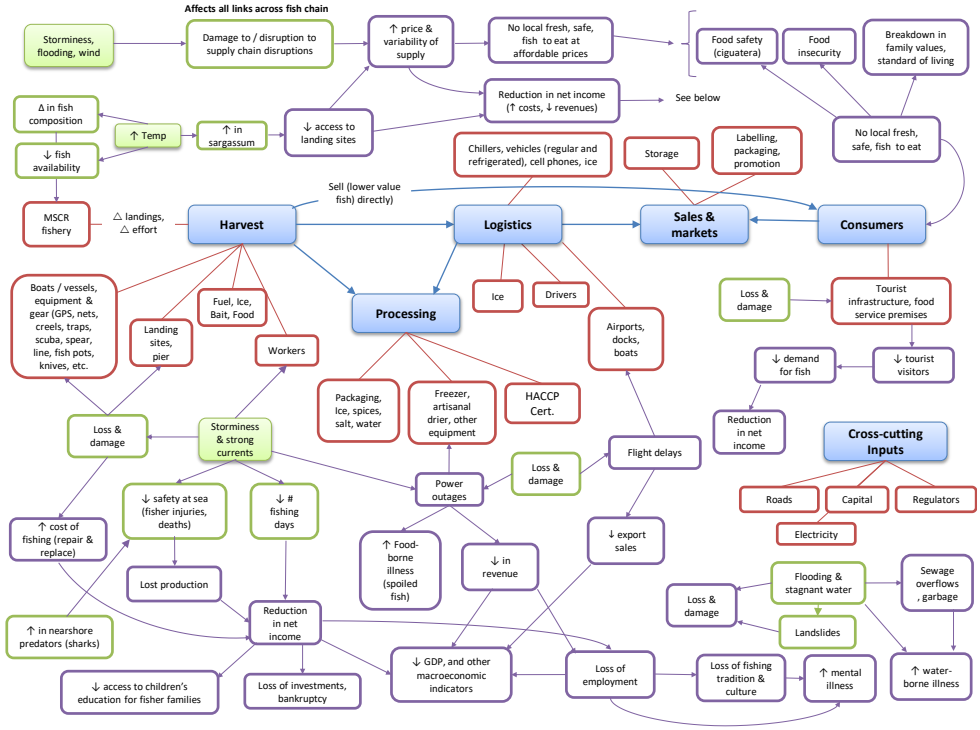
In both fisheries in Figure 8, the sector was defined to include the following activities (denoted by the blue shaded boxes): harvesting (commercial, subsistence, sport); markets or points of sale (including exports); logistics (vendors, distributors, all transportation); and domestic consumers (individuals and households, hotels, restaurants etc.). The pelagic fishery also included a governance activity. Inputs to activities are signified by red boxes. Climate stimuli are represented by green shaded boxes, with first-order physical impacts shown in green unshaded boxes. During the workshop only two significant climate stimuli were considered—SSTs and storms. Participants linked rising SSTs with changes in fish distribution and abundance, a decline in fish availability, increased presence of predators nearshore, and increased prevalence of Sargassum. The latter two were identified for the mangrove-sea grass-reef fishery only. The main first-order impacts resulting from storms are a decrease in the number of days fishing, increased safety risks at sea, landslides, flooding, loss of/damage to infrastructure and assets, disruption to the flow of goods and services across the sector. First-order impacts give rise to an array of cascading, second-order impacts and consequences; represented by purple boxes.

The conceptual models of climate-related socio-economic impacts and corresponding consequences shown in Figure 8 serve several purposes:

- They help identify the “end-point” consequences that need to be measured in the socioeconomic assessment, and relatedly, the completeness of the estimates generated (as one can readily observe which of all relevant consequences have been quantified). Ideally, the quantification effort would focus on priority impact-consequence pathways; however, there was insufficient time at the workshop to determine priority pathways.

- Knowledge of the impact-consequence pathways helps structure the quantification algorithms and data (indicator) needs for calculating socioeconomic impacts. Indicators for ongoing monitoring are drawn from these data.
- Multiple pathways may result in a single consequence; equally, a single pathway may result in multiple consequences. Understanding the pathways is thus essential to avoiding double counting (overlap) during quantification.
- Finally, understanding the pathways that link climate-related impacts, first- and second-order impacts, and end-point consequences is essential to identifying entry points for adaptation interventions.

(A) Mangrove-Seagrass-Coral Reef Fisheries



(B) Pelagic Fisheries

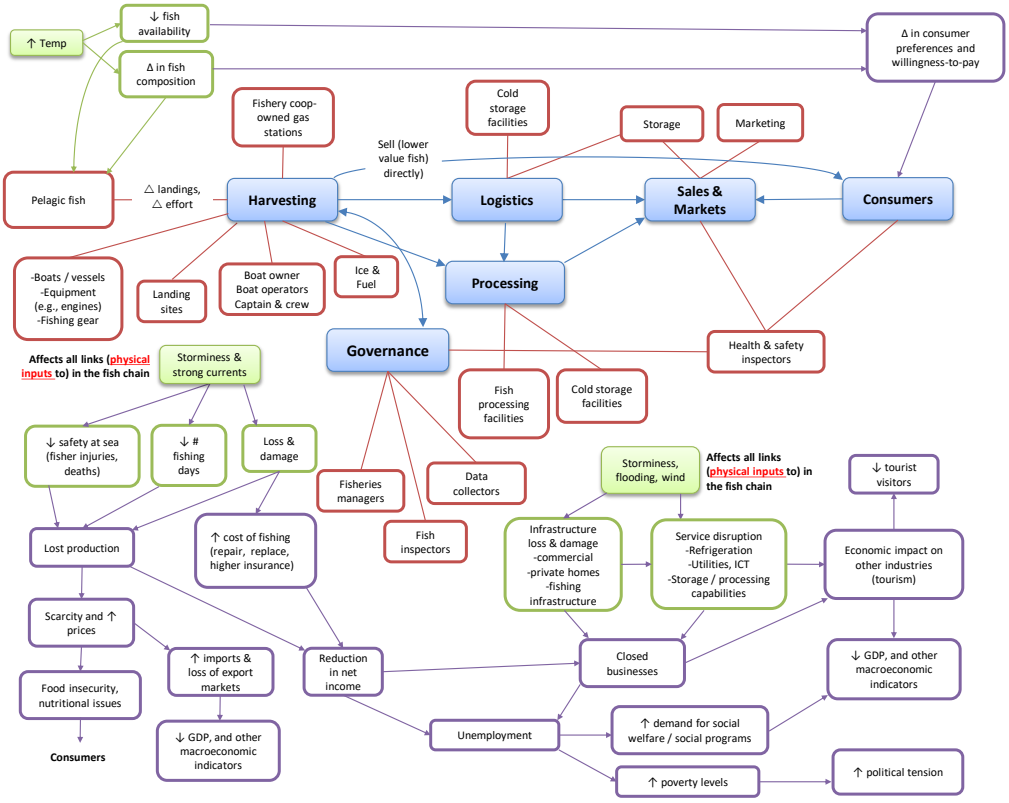


Figure 8: Conceptual models of the (A) seagrass-mangrove-coral reef fisheries and (B) pelagic fisheries visualized using PowerPoint. Blue shaded boxes represent the key fisheries-sector activities, boxes outlined in red represent assets and inputs into these activities; green shaded boxes and outlines represent climate- drivers and direct impacts; boxes outlined in purple represent social and economic consequences of the direct impacts.

Direction of socio-economic assessment

Based on the conceptual socio-economic impact models developed from workshop outputs, the project team defined the direction of subsequent work on the socioeconomic assessment task.

The sheer number of relevant impact-consequence pathways identified precludes a full bottom-up (or "effect-by-effect") approach to measuring climate-related socioeconomic impacts on the fisheries sector in the six PPCR countries. Fortunately, many pathways lead to a small set of end-point consequences. This lends itself to a more top-down approach, measuring climate-related impacts on the fisheries sector directly through estimated changes to macroeconomic indicators, such as sectoral /national output, value added or GDP, employment, imports, exports, balance-of-payments, consumer prices, among others. This top-down approach will work for tangible socioeconomic impacts only, arising from changes to the frequency/intensity of (tropical and hurricane) storms and increasing SST (and other changes to fish ecosystems).

Assessing impacts from storms will need to be based on historical analogues from the region—reviewing (a) past damage assessments of storms of defined intensities and (b) sectoral macroeconomic indicators before and after landfalls, and subsequently estimating relationships between events of defined intensities and changes to sectoral macroeconomic indicators, which can be scaled to the six PPCR countries. Climate change is introduced through projected changes to the frequency/intensity of storms under RCP 2.6 and RCP 8.5 for the 2050s and 2080s.

Assessing socioeconomic impacts from the effects of climate change (including rising SST) on the fish ecosystem, starts from estimates of total catch (in physical and dollar terms) and the composition of the catch (as a function of fishing effort (in dollar terms) and the stock biomass) under RCP 2.6 and RCP 8.5 for the 2050s and 2080s. Landings will need to be traced through the value chain to intermediate (inter-industry) and final demand (households and exports), to estimate macro-level impacts. This will require close coordination between the ecological assessment and value chain analysis. The baseline scenario for storms would be a future with higher SST and corresponding fisheries.

For both rising SST and increased storminess, two intangible impacts will be assessed: (a) impacts on food security at a macro-level; and (b) impacts on income and non-income poverty. In both cases, impacts will be assessed by estimating changes to established indicators used in the region, with changes to the indicators driven by output from the analyses described above. We anticipate linking this part of the assessment to the value chain analysis, at least in terms of working with some of the same indicators.

Ongoing sea level rise (SLR), which may adversely impact coastal infrastructure that supports the fisheries sector, was not considered at the workshop. However, its omission was solely due to time constraints, as opposed to an agreed lack of importance. The project team will need to investigate the case for including SLR in the assessment. Key questions to answer are: How much infrastructure is exposed to SLR? How vulnerable is exposed infrastructure? To allow sufficient budget to adequately assess the socio-economic impact of the other two main climate stimuli we are likely to cover SLR through the development of one or two case studies.

A methodological issue that has yet to be resolved by the project team relates to the use of a static or projected socioeconomic future for the assessment (this issue is illustrated in Figure 9). The former assumes, for example, that future climate conditions are overlaid on today's Jamaica. The latter assumes that future climate conditions are overlaid on a future Jamaica, which is characterized by one or more socioeconomic futures (e.g., projections of population, income, economic structure, technology etc. over similar time horizons to the climate scenarios used in the assessment). Overlaying climate change on today's Jamaica is the more practical option—especially in data-limited environments. However, the real socioeconomic impact of climate change on fisheries involves analyzing a projected fishery with and without projected climate change.

Since the ecological modelling will incorporate simple / idealized management scenarios to depict alternate levels of fishing and related implications in combination with climate change impacts, it will be important to, at a minimum, reflect related assumptions about future society in the socio-economic impact assessment.

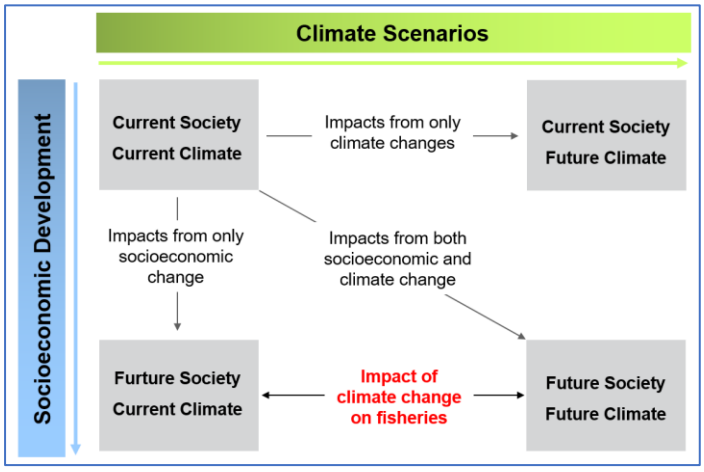


Figure 9: Separating impacts of climate change and socio-economic development

4. CLIMATE-SMART FISHERIES MONITORING SYSTEM

Authored by Mr. Tim Webb, this section summarizes the written feedback workshop participants provided on several aspects of the monitoring system and the scoping implications of this feedback for project activities under Work Package 2.

Results from workshop discussions and preliminary research

Potential indicators

The ultimate selection of indicators recommended for the monitoring system will depend on input from the ecological and socio-economic assessments (Work Package 1). However, to get an initial sense of where priorities and interest might lie, we have organized feedback on this question from participants into the following broad categories and highlighted the ones that had the most support in **boldface**.

Indicator types	
Physical Sea surface temperatures Weather parameters rainfall wind **sea conditions – especially those that interfere with fishing** pH and other chemistry/water quality variables including pollutants and solid waste **Ocean currents (particularly unusual ones)**	Ecological Species distribution and abundance Coastal species – productive fishing grounds Pelagic fish migration patterns **Habitat mapping - Mangrove, seagrass, coral – health and status** **Sargassum – forecasting and monitoring**
Catch and effort Key commercial species like lobster and conch Artisanal, subsistence fisheries Parrot fish **Catch sampling – species, fish sizes, ages, maturity, condition factor etc. for coastal and pelagic species**	Socio-economic **Active fisher population (Fisher registration)** **Vessels in the fishery (Vessel registration)** Market demand for key species **Destination of fish – local consumption, export** Fish imports Ex Vessel prices **Fisher revenue and costs - Household incomes**
Risks and hazards **Damage to boats, houses, infrastructure from storms, floods, etc.** Rate of recovery of biological and human systems Ability of fishers to adapt – vulnerability recovery index	Management effectiveness of fisheries sector (Saint Lucia)

Table 5: Indicators recommended by workshop participants for inclusion in the climate-smart monitoring system

Monitoring system purpose

In the workshop we discussed the different purposes that a monitoring system might address. These are concisely summarized in the following quote: *"… monitoring is the process of measuring attributes of the ecological, social, or economic system. Monitoring has multiple purposes, including: to provide a better understanding of spatial and temporal variability, to confirm the status of a system component, to assess trends in a system component, to improve models, to confirm that an action was implemented as planned, to provide the data used to test a hypothesis or evaluate the effects of a management action, and to provide*

an understanding of a system attribute that could potentially confound the evaluation of action effectiveness."[20]

The indicators proposed by the participants in the planning workshop focus largely on monitoring key attributes of the entire fisheries system (ecological and socio-economic) both to understand the current status but also to detect changes over time due to climate change and other factors. Monitoring to determine the effectiveness of specific management actions and policies was not given a high priority by participants.

Existing monitoring and related systems

Fishery monitoring, data collection, and data management systems vary widely among the six countries involved in this project but in all cases substantial challenges were identified related to levels of funding, training, systems, and support. Activities currently focus on the collection of catch and effort data from trip interviews at key sites, interviews and data from processors, and additional socioeconomic data from household surveys that are not focussed specifically on fishers. However, sample sizes tend to be small and sampling strategies are often not well developed.[21]

Enhancing these existing monitoring activities with additional resources and/or better sampling designs is critical for improving data quality but this requires a sustained effort. Participants discussed opportunities for gathering additional data directly from fishers and processors that could be implemented more rapidly. Options included the development of enhanced log book programmes, stakeholder meetings, additional interactions at landing sites, and targeted censuses of all those involved in the fishery. For some countries there are initiatives[22] under way to address some of these aspects at a national level. Other countries are using poorly-supported software tools (e.g., CARIFIS), have limited capacity and would benefit from new tools developed at a regional level.

The CARIFIS regional tool developed by CRFM for their 17 member countries has been broadly used in the past but needs substantial redevelopment using more modern software tools and components if it is to be supportable going forward.[23] CARIFIS has predominantly been used for vessel registries, fisher registries, and trip interview reports. The database schema and form structure are potentially useful as input to the development of a replacement system but the software itself will need to be redeveloped from scratch.

Regionally, there are monitoring and data collection initiatives underway that will provide important data for climate-smart fisheries management. Some of these involve extensive mapping from aircraft or satellites that address some of the monitoring variables identified in the workshop. For example the Nature Conservancy has recently launched a project for the high resolution mapping of shallow waters, in particular coral reefs, with plans for expansion to the entire Caribbean Basin. The Sargassum Watch System (SaWS) is designed to use satellite data and numerical models to detect and track pelagic Sargassum in near-real time, feed results to a Web portal, and provide decision makers timely information on seaweed location and warnings for potential beaching events. Setting up protocols to ensure that this type of data is accessed and made available to countries for their own assessment and management will be an important objective of our project.

[20] Fischenich, J.C., K.E. Buenau, J.L. Bonneau, C.A. Fleming, D.R. Marmorek, M.A. Nelitz, C. L. Murray, B.O. Ma, G. Long and C.J. Schwarz. 2016. Draft Science and Adaptive Management Plan. Report prepared for the U.S. Army Corps of Engineers, Washington, DC. 544 pp. http://moriverrecovery.usace.army.mil/mrrp/f?p=136:70:0:::::

[21] Barnwell, S. 2014. Review of Fisheries Data Collection Systems in Selected CRFM Member States and Recommendations for Integrating FAD Fisheries. CRFM Technical & Advisory Document No. 2014 / 7. 26p.

[22] Jamaica FISHLINK project (2018-2023), expanded general agriculture and fisheries database in Dominica, and new fisheries database proposed in Haiti.

[23] Masters, J. 2012. Overview of the Status of Performance of CARIFIS in CRFM Member States, and Options for the Way Forward. CRFM Technical & Advisory Document – Number 2012 / 4. 44p.

Over the years a number of different protocols and tool sets have been developed that were raised by workshop participants. These are relevant in the Caribbean and should be considered in developing the Climate-Smart Monitoring System including such tool sets as: ARTFISH (Approaches, Rules and Techniques for Fisheries statistical monitoring) developed by the Fisheries and Aquaculture Department of the FAO; the Atlantic and Gulf Rapid Reef Assessment (AGRRA) program; and the FAO Fishery Performance Indicator (FPI) approach.

The CRFM is currently rolling out a new safety oriented mobile application for Android and iOS devices; the Fisheries Early Warning and Emergency Response (FEWER) tool. FEWER is focussed on emergency warning rather than monitoring but it does target a similar audience and can potentially provide useful lessons for the development of other sustainable tools.

Participants identified several different regional agencies and institutions that could be involved in a monitoring system. The CRFM was identified as a key core agency along with universities (UWI Centre for Resource Management and Environmental Studies (CERMES) at Cave Hill in Barbados, UWI Mona Office for Research and innovation (MORI) in Jamaica, and St. George's University Grenada). Participants also noted the importance of ICCAT and various FAO groups.

Technology issues

In most of the countries technical support and training are limited making it difficult to implement and maintain new systems. Most fisheries departments are currently using the Microsoft Office Suite of tools particularly Excel with some departments also using Access. Microsoft Access provides relational database capabilities with a relatively low level of infrastructure and training. There are persistent rumours that Microsoft plans to stop supporting Access and this has made it less desirable as a foundation for new tools but so far there has been no official announcement.

With a relatively high level of proficiency in Excel this might seem to be an appropriate way to introduce some more sophisticated data management capabilities along with appropriate scripting and interfaces. However, Excel is not an ideal data management tool, can be error prone, and does not handle very large data sets well. It does have the advantage that many people can use it.

Spatial data tools such as ArcGIS were mentioned by a number of participants and are clearly a key part of a Climate-Smart Monitoring System for the region. The capabilities of the countries with GIS tools will need to be further assessed as the project moves forward.

Implementation issues

Workshop participants were clear that they were primarily interested in tools that could be used internally within their fisheries departments rather than regional/shared systems. This approach gives them maximum control of their own databases while supporting data exchange through standards and templates.

The biggest concern raised with both regional and national systems was how they could be sustained in the long term, including the provision of technical support, training, and upgrading as software systems evolve. Systems must be sustainable, practical, take into account the capacity of implementing departments, and accommodate regional differences.

There were varying opinions on data sharing but overall participants felt that it was important to develop a policy for the Climate-Smart Monitoring System to ensure efficient sharing of data and information. Countries will need to have the flexibility to define what information they do not want to share but in general the information should be shared broadly with government agencies, NGOs, and the fisher community.

Proposed monitoring system scope

The core fisheries statistics and monitoring infrastructure in each of the six PPCR countries in our project require substantial work to make them more useful for day to day management and longer-term monitoring. The gaps are not in the capability of the fisheries staff but rather in the level of resourcing, training, and long-term support required to develop sustainable systems. Addressing these issues requires a larger and longer-term effort than we can provide through our two-year project.

Because we are not able to guarantee long term systems support it is not realistic or useful for this project to build real-time data management systems for dynamic capturing of data across all of the islands. Without ongoing support and training such tools would rapidly become irrelevant.

What we *can* do in this project is provide a repository of the data used in our analyses and the results along with some tools to replicate and update analyses, and training on how to work with this data. We can also provide detailed information on what should be monitored, some details on monitoring protocols and guidance on what information should be captured (which could potentially include sample data forms).

For the countries selected for pilot study sites we can also work with fisheries managers and others on how to integrate this new information with their existing and planned systems. We may be able to provide a few simple software tools to assist with this but we are very aware that these would need to be easily supportable and maintainable if they are to continue to be used.

In the terms of reference for this project the scope of the main deliverable for the climate-smart fisheries monitoring system was, in summary, to: develop, install, load, test, document, and provide training on a database to house all inputs and outputs of the consultancy, to facilitate follow-up management of the data, assessments and analyses. Also, to provide a metadata catalog, and software and hardware specifications. With the information gathered from the regional planning workshop we can now be more specific on the main components of the monitoring system. They are as follows:

A. **Project repository** consisting of a database and associated tools. The database will contain the core information used as inputs in the ecological and socio-economic assessment work and the key results. It's important to note that although a database management system is beyond the scope of the project and this repository will likely be a static database, we will explore options to permit adding data sets over time. As described in the project terms of reference this will be supported with appropriate documentation and training.
B. **Metadata catalog** to provide a searchable index to the different data sources available in the project repository as well as other sources identified during the project from third parties.
C. **Data dictionary**. While we are not proposing to develop a single database for all related monitoring data, we can provide a recommended set of variables including units and associated information that can be used by individual countries in augmenting existing database systems or designing new ones.
D. **Recommended monitoring** including variables, sampling strategy, and proposed methods. The monitoring variables will be selected based on the information we have gathered from workshop participants, the conceptual modelling of both biological and socioeconomic systems, and the expert judgement of our team.
E. **Information sharing** portal. At the workshop we discussed the importance of providing mechanisms for supporting communication and data sharing both during this project and in the longer terms. We will evaluate the DGroup system configured by CRFM and some alternative systems as platforms to exchange information (e.g., new project initiatives with the potential to contribute to an understanding of the sector's vulnerability to climate change) and data, and to support building a community of practice focused on climate-smart fisheries management.

F. **Information to be gathered and shared** from other agencies and projects. As noted above, an important part of strengthening the information base for climate-smart fisheries management will be ensuring that countries have access to monitoring results from regional and international agencies. This component includes cataloging these sources and providing protocols on how to access and work with their data.
G. **Recommendations on systems approaches**. We will work with the three pilot study site countries to assist them with data collection and management issues including how to integrate new data with existing or proposed systems.

Next steps

Much of the work on the monitoring system will be carried out after the assessment component (Work Package 1) is complete. However, there are some important tasks that need to be carried out in parallel:

- Confirm and/or update the scope of the monitoring system described in the previous section.
- Work with each of the three pilot study site countries to further understand their capabilities and current and proposed data systems so that we can provide input and recommendations.
- Ensure that key input and output data for the assessments is being captured in an appropriate format and that tools are collected and documented where appropriate.
- Design the project repository and metadata catalog.

5. STAKEHOLDER ENGAGEMENT AND COMMUNICATIONS

Authored by Ms. Ava-Gail Gardiner, this section summarizes scoping considerations for project activities under Work Package 3 and emerging ideas on products for the awareness-raising campaign.

General considerations

Recognizing that Caribbean people's lives and cultures are centred around the sea; that there are many common impacts of climate change being felt across the region; and that fisheries are being seriously affected are all facts that underscore the need for a united approach to addressing climate change in the Caribbean fisheries sector. However, we are also reminded that each island has its own specific nuances and when climate change adaptation or mitigation measures are juxtaposed against other development priorities, a delicate balance has to be struck. Budgetary limitations pose additional challenges and the project team will need to be strategic on how we prioritize the issues, and devise messages and approaches to effectively address the identified priorities in cost-efficient ways.

As the project evolves, there will be opportunities for learning and knowledge sharing. Given the specificities of each island, a case study approach might be useful in documenting the communications component, and aspects of the wider project. As the Project Working Group represents a network of institutions across the six countries, this body could be instrumental in promoting the communications component, serving to highlight key themes and recommendations for adopting a social learning approach to communicating climate change and adaptation.

Target audiences for the KAP study

Discussions during and at the margins of the Regional Planning Workshop, combined with responses to the draft KAP survey, helped narrow down target audiences for initial activities under this Work Package. Our proposed target audiences are as follows. These are the groups that we will target for the KAP study and likely for stakeholder engagement and communications activities overall.

- Fishers/ harvesters and other value chain actors. Field work will need to be cross-referenced with the Value Chain Management Specialist to ensure that the questions on the KAP enhance rather than duplicate those on the Value Chain questionnaire.
- Youth in coastal / fishing communities.
- Ministers/ CRFM Ministerial Council. The intent is to cover policy-focused questions that take into account national development priorities and climate change responses, as well as regional planning for fisheries sector.
- Technocrats / Fisheries Managers. The draft KAP already reached a subset of these stakeholders but we will seek to expand our reach during the actual deployment of the KAP survey.

Communications highlights and emerging ideas

Through activities and interviews with participants during the two-day workshop our Communications and Media Specialist was able to collect quotes and micro-stories that brought to life issues such as the value of data and the importance of and opportunities in youth empowerment.

- *"After the devastation of Hurricane Maria, Dominica discovered that there was a serious data void. The gaps in the availability of relevant data and information in some instances have hampered strategic interventions in the emergency recovery phase. The most critical outcome of this project will be a comprehensive ecological assessment. This is something that Dominica absolutely needs in order to recover, and more so as we aim to become the first climate resilient country in the world."* Mr. Jullan Defoe, Senior Fisheries Officer, Dominica, on the value of data
- *"My father is a fisherman, so I learnt the basics from him. At times it was hard, but fishing was what I grew up around and it was generally quite positive. Nowadays we use new methods, like FADs and technology (apps like FEWER, FishTrack) and this is taking a lot of the guess work out of fishing".* Mr. Royan Isaac, Fisherman & President of Grenville FAD Fishers Organization Inc., Grenada, on engaging youth and knowledge sharing.
- Hudson Toussaint is a young fisherman from Dominica who had built a successful business from scratch over 3 years (2013-2016). After his entire fleet of 4 boats was wiped out by Hurricane Maria, he is slowly rebuilding. This time, he is acutely aware of climate change and is focused on risk-reduction and sustainability.
- Since 2011, massive quantities of floating sargassum seaweed have floated throughout the Caribbean, impacting marine resources, fisheries, shorelines, waterways, and tourism. The amount of observable weed has lessened since the largest bloom of October 2015; however, this process is cyclical and the coming 2017-2018 season is projected to see a significant increase of this ocean-carried weed. Sargassum is seen as a nuisance in the Caribbean. At the same time many islands have very high levels of youth unemployment so the potential exists to explore turning the sargassum into valued products. In Saint Lucia a young entrepreneur has created a community enterprise that harvests the sargassum and uses it to make organic fertilizer.[24]

Results of the KAP survey will inform messages; SMART objectives; considerations for effective transmission and reception; and the substance and form of engagement and communications activities. However, a few early ideas on products are as follows:

- An information kit with strategy and tools to assist Fisheries Officers to communicate climate change and fisheries messages more effectively;
- A brochure or pamphlet on how to harvest sargassum sustainably (while preserving the beaches), and how to use it to make fertilizer (wet or dry) and what business support is available for aspiring entrepreneurs;

[24] http://www.caribbean360.com/news/communities-innovate-to-address-sargassum-seaweed-on-st-lucias-coasts

- A radio drama mini-series, with regional relevance/ appeal. This mini-series would address climate change impacts, and promote proactive responses including adaptation. Other key themes can include youth empowerment – knowledge sharing/ capacity building (note: intergenerational knowledge transfer); social challenges, public health, disaster management/ risk-reduction.

Next steps

The focus in the next quarter is to complete data collection instruments for the KAP study, plan and roll-out the KAP activities (online survey, in-person interviews and focus-group discussions), analyze data from KAP activities and develop the stakeholder engagement and communications strategy. For this to take place effectively a decision on the pilot study sites is required.

APPENDIX 1 TO ANNEX III: WORKSHOP PARTICIPANTS' LIST

	COUNTRY	PARTICIPANTS' NAMES & DESIGNATION	ADDRESS
1	Dominica	Mr. Jullan DeFoe Senior Fisheries Officer	Fisheries Division Ministry of Agriculture and Fisheries Roseau Fisheries Complex Dame Eugene Charles Boulevard, Roseau Tel: (767) 266-3282 Email: jullan.defoe@gmail.com
2		Mr. Hudson Toussaint Fisher	Email: hudsontoussaint@gmail.com
3	Grenada	Mr. Crafton Isaac Chief Fisheries Officer (Ag.)	Fisheries Division Ministry of Agriculture, Lands, Forestry, Fisheries and the Environment Melville Street Fisheries Complex St. George's Tel: (473) 440-3814 / 440-3831 Fax: 473-440-6613 Email: crafton.isaac@gmail.com fisheries@gov.gd
4		Mr. Royan Isaac President and Chair	Grenville FAD Fishers Organization Inc. Victoria Street, Grenville St. Andrews Tel.: (473) 418-7276 / 442-7620 Email: freshboy885@gmail.com
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7	Jamaica	Ms. Anginette Murray	Fisheries Division Ministry of Industry, Commerce, Agriculture and Fisheries P.O. Box 470, Marcus Garvey Drive Kingston 13 Email: anginettemurray@gmail.com anginettem@yahoo.com
8		Mr. Ian Jones	Fisheries Division Ministry of Industry, Commerce, Agriculture and Fisheries P.O. Box 470, Marcus Garvey Drive, Kingston 13 Email: ikjones007@yahoo.com
9	Saint Lucia	Ms. Allena Joseph Fisheries Biologist	Department of Fisheries Ministry of Agriculture, Food Production, Fisheries, Co-operatives and Rural Development Point Seraphine Road, Castries Tel.: (758) 468-4139 / 725-2080

	COUNTRY	PARTICIPANTS' NAMES & DESIGNATION	ADDRESS
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11	St. Vincent & the Grenadines	Mr. Shamal Connell Fisheries Officer	Fisheries Division Bay Street, Kingstown St. Vincent & the Grenadines Tel.: (758) 456-2738 Email: volcanicsoils@hotmail.com
12		Mr. Maxwell John Agricultural Officer	Ministry of Agriculture, Forestry, Fisheries, Rural Transformation, Industry and Labour Richmond Hill, Kingstown
13	CRFM Secretariat	Dr. Susan Singh-Renton Deputy Executive Director	CRFM Secretariat Top Floor, Corea's Building Halifax Street, Kingstown Tel.: (784) 457-3474 Email: susan.singhrenton@crfm.net susan.singhrenton@crfm.int
14	ESSA Team (Consultants)	Ms. Jimena Eyzaguirre Team Leader and Senior Climate Adaptation Specialist	ESSA Technologies Ltd. Ottawa, Canada (613) 798-1300 x 5 jeyzaguirre@essa.com
15		Mr. Tim Webb Database Design and Development Expert	ESSA Technologies Ltd. Vancouver, Canada (250) 720-3063 twebb@essa.com
16		Dr Natascia Tamburello Marine Systems Ecologist	ESSA Technologies Ltd. Vancouver, Canada (604) 677-9561 ntamburello@essa.com
17		Dr William Cheung Fisheries & Marine Ecosystem Assessment Expert	Associate Professor, The University of British Columbia Vancouver, Canada (604) 827-3756 w.cheung@oceans.ubc.ca
18		Dr Ahmed Khan Value Chain Management Expert	Khan & Associates Sustainability Consulting Inc. Jacksonville, United States ahmedk@mun.ca
19		Ms. Ava-Gail Gardiner Communications and Media Expert	Creative Director, Change Communications Ltd. Kingston, Jamaica (876) 873-6101 agardiner@consultant.com

APPENDIX 2 TO ANNEX III: WORKSHOP AGENDA

Day 1: Wednesday, April 25, 2018

Time	Activity
8:00am –8:30am	**Registration**
8:30am-9:00am	**Introductions and Opening Remarks** Participant introductions Welcome and opening remarks (*CRFM*)
9:00am-9:15am	**Workshop Overview** Overview of workshop objectives, agenda for the two days, expected outputs, ground rules and introduction to a tool to help gauge level of comfort (*Project Team Leader, Jimena Eyzaguirre*)
9:15am-9:45:am	**Project Overview -"Fishery-Related Ecological and Socio-economic Assessments of the Impacts of Climate Change and Variability and Development of an Associated Monitoring System"** Objectives, main activities, milestones and outputs (*Project Team Leader, Jimena Eyzaguirre*)
9:45am-10:00am	*Coffee Break*
10:00am-11:00am	**An Introduction to Ecological Modelling Used in the Project** Regional modelling approach, key inputs and outputs Introduction to conceptual modelling and impact pathways - what is it and how are we applying it (*Fisheries & Marine Ecosystem Assessment Expert, William Cheung)*
11:00am-12:00pm	**Mapping the Pathways of Climate Change and Ecological Impacts - Pelagic Fisheries** Instructions; Conceptual modelling exercise in sub-groups (*Fisheries & Marine Ecosystem Assessment Expert, William Cheung)*
12:00pm-1:00pm	*Lunch*
1:00pm-2:30pm	**Mapping the Pathways of Climate Change and Ecological Impacts - Reef Fisheries & Mangrove / Seagrass Fisheries** Same sequence of activities as above
2:30pm-3:30pm	**Mapping the Pathways of Climate Change and Ecological Impacts** Plenary discussion on differences per country, uncertainties, data and management levers *(Fisheries & Marine Ecosystem Assessment Expert, William Cheung)*
3:30pm-3:45pm	*Coffee Break*
3:45pm—4:30pm	**Proposal to Form a Project Working Group** Presentation on terms of reference of proposed Project Working Group (*Project Team Leader, Jimena Eyzaguirre*) Round table discussion and decision
4:30pm-5:00pm	**Preparation for Day 2** Participant feedback - hopes and concerns for this Project Overview of key agenda items for Day 2
5:00pm	*Adjourn*

Day 2: Thursday, April 26, 2018

Time	Activity
8:00am –8:30am	**Arrival**
8:30am-8:45am	**Introduction** Review of Day 1 and overview of agenda (*Project Team Leader, Jimena Eyzaguirre*)
8:45am-9:15am	**An Introduction to Socio-economic Assessment Approaches Used in the Project** Value chain analysis and Socio-economic impact assessment: key inputs, outputs and complementarities *(Value Chain Management Specialist, Ahmed Khan)* Using conceptual modelling and impact pathways - linkages to the ecological work (*Project Team Leader, Jimena Eyzaguirre*)
9:15am-9:30am	*Coffee Break*
9:30am-12:00pm	**Mapping the Pathways of Climate Change and Socio-economic Impacts** Instructions Sub-group work to identify socio-economic impacts of climate change and prioritize impacts on land-based assets and resources of the fisheries sector Participant exercise to identify differences per country, uncertainties, data and management levers (*Project Team Leader, Jimena Eyzaguirre*)
12:00pm-1:00pm	*Lunch*
1:00pm-2:30pm	**Defining a Climate-Smart Fisheries Monitoring System** Presentation on purpose, functions and potential options as an output of the CRFM PPCR project Round table discussion based on seeding questions provided *(Database Design & Development Expert, Tim Webb)*
2:30pm-2:45pm	*Coffee Break*
2:45pm-3:30pm	**Selecting Pilot Study Sites**** Presentation on purpose of pilot study sites, selection criteria, options assessed and resulting recommendations (*Value Chain Management Specialist, Ahmed Khan*) Round table discussion and decision
3:30pm—4:45pm	**Strategic Communications on Fisheries Climate Adaptation and Disaster Risk Reduction** Primer on climate change communications and related training Presentation on preliminary communications messages by target audience Round table discussion to improve strategic communications *(Media & Communications Expert, Ava-Gail Gardiner)*
4:45pm-5:15pm	**Closing and Next Steps** Participatory evaluation – what worked well, what could be improved (All) Recap action items (*Project Team Leader, Jimena Eyzaguirre*) Closing remarks *(CRFM)*
5:15pm	*Adjourn*

** We deferred this discussion to a follow-up meeting due to time constraints

APPENDIX 3 TO ANNEX III: WORKING GROUP TERMS OF REFERENCE

CRFM PPCR Fishery Assessment and Monitoring Study Working Group
Terms of Reference
May 18, 2018

Background
Marine fisheries are complex, deeply connected socio-ecological systems. To manage a given fishery resource effectively, practitioners must account for ecological interactions with other marine species and socio-economic interactions with resource users. Climate change and variability add to the challenge of sustainably managing the fisheries and aquaculture sector in the Caribbean.

Because of the sector's economic, social and ecological importance in the Caribbean there is an urgent need to improve understanding of climate risks and potential impacts, the sector's vulnerability and options to enhance climate resilience.

The Inter-American Development Bank has invested in supporting the region's climate resilience, through grant funding for the regional track of the Pilot Program on Climate Resilience (PPCR). The "Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System" project ("the Project") delivers on the PPCR regional track. Executed by the Mona Office for Research and Innovation (MORI) at the University of West Indies at Mona, Jamaica, and with the Caribbean Regional Fisheries Mechanism (CRFM) as the co-implementer and service beneficiary, *the Project aims to improve availability and use of information for "climate-smart" planning and management in the fisheries and aquaculture sector in the Caribbean.* The Project consists of six participating countries, which are the direct beneficiaries - Jamaica, Haiti, Dominica, Saint Lucia, Grenada and Saint Vincent and the Grenadines. Each of these also has a national PPCR program. ESSA Technologies Ltd. (ESSA) has been selected to undertake the contract for completion of this Project.

The Project includes 4 Work Packages:

- Work Package 1: Assessment
- Work Package 2: Climate-Smart Fisheries Monitoring System
- Work Package 3: Stakeholder Engagement and Communications
- Work Package 4: Integration of Climate Risk and Resilience into Regional Fisheries Development and Planning

The Project kicked off on January 24, 2018 and will run 24 months.

Purpose of the Working Group
The CRFM PPCR Fishery Assessment and Monitoring Study Working Group ("the Working Group") will provide advice to ensure the relevance of Project outputs and operational support to maximize the efficiency of Project implementation. Engagement of the Working Group will contribute to meeting the Project's success indicators, presented below:

Process
A project process that includes high level of meaningful consultation with stakeholders from the 6 PPCR countries
Project outputs that are nationally-relevant with potential for regional applicability
A high potential for sustainability of results in the absence of CRFM support
Outcome
Increased information available on climate change impacts on fisheries and resilience options
Increased understanding by technical, policy and industry / fisher folk of climate change impacts on fisheries and resilience options

Objectives of the Working Group

1. To maximize the relevance of Project outputs related to all four Work Packages;
2. To facilitate Consultants' access to datasets / information and stakeholders throughout the Project;
3. To build stakeholder awareness on methodologies, information and tools resulting from Project implementation, in Members' respective countries;
4. To build on the information and recommendations for improving management of fisheries stemming from the Project (e.g., assessment approaches and results, monitoring tools and proposed management strategies for climate change adaptation of fisheries activities).

Roles

The role of *Working Group Country Members* is to:

a. To monitor, gather and provide feedback on Project outputs in early stages of development and as they are completed, ensuring that country-specific views are known;
b. To share data and information holdings with the Consultants or advise on efficient mechanisms to gain access to the data and information from external sources;
c. To facilitate expert and stakeholder participation in Project activities;
d. To communicate matters related to Project activities to stakeholders and members of the public.

Working Group Members are not expected to be the sole expert providing feedback on Project activities on behalf of their member country. Rather, in addition to expert resources, Working Group Members will act as liaisons between the Project and networks of experts and stakeholders in their member countries.

The role of the *CRFM Secretariat* is to:

a. To assist with coordination of Working Group activities;
b. To co-evaluate the functioning of the Working Group and recommend improvements;
c. To facilitate the development of regional and international institutional linkages for the purposes of sharing information on climate change and fisheries assessment, monitoring, communications and management.

The role of the *Consultant* is to:

a. To develop and maintain a calendar of Working Group activities, engaging Working Group members with a frequency that maintains Project momentum;
b. To chair and facilitate Working Group meetings (electronic);
c. To co-evaluate the functioning of the Working Group and recommend improvements;
d. To report on key advice provided, decisions reached and action items stemming from Working Group activities;
e. To integrate advice and feedback from Working Group Members into Project activities.

Operation
The operation of the Working Group will consist of regular meetings by teleconference and web-based platforms (GoToMeeting). Depending on the issues up for discussion, meeting can include the whole Working Group or a subset of members. The Consultant will prepare the agenda and supporting documents five business days ahead of each meeting and chair each meeting.

Within reason, out-of-session advice and review of documents will also be required. This may include written feedback on and discussion in response to specific questions elicited and provided through a DGroup forum.

The expected level of effort for country members and the CRFM Secretariat to participate in Working Group activities is up to five hours per month, on average, for the duration of the Project.

Obligations and Responsibilities
In accepting appointment on the Working Group, country members and the CRFM Secretariat must be prepared to:

- Contribute knowledge of and experience in regional and national fisheries.
- If requested, connect the Consultant and stakeholder peers in fisheries management agencies, academic organizations, fisherfolk organizations, industry bodies and other organizations as necessary.
- Constructively participate in discussions to achieve acceptable outcomes.
- Respect the views expressed of other Members.
- Act in the best interests of the regional fisheries sector as a whole, taking into account the needs and aspirations of the stakeholders most vulnerable to the impacts of climate change.

In launching and managing operation of the Working Group, the Consultant must be prepared to:

- Structure meetings and other Working Group activities in a way that makes the best use of country members' and the CRFM Secretariat's time.
- Contribute knowledge on ecological modelling and assessment, socio-economic impact assessment, monitoring systems, strategic communications and fisheries adaptation.
- Coordinate requests for the Consulting team's access to country members and national stakeholders to prevent consultation fatigue.
- Constructively participate in discussions to achieve acceptable outcomes.
- Respect the views expressed of other Members.
- Act in the best interests of the regional fisheries sector as a whole, taking into account the needs and aspirations of the stakeholders most vulnerable to the impacts of climate change.

Membership
Membership will comprise one representative from each participating country- a Fishery Assessment and Monitoring Study Liaison Officer- and an alternate. Representatives are expected to serve on the Working Group for the duration of the Project, unless their affiliations change, in which case a new Fishery Assessment and Monitoring Study Liaison Officer would be assigned to the Working Group.

The following table outlines the composition of the Working Group:

Representation	Name	Position, Affiliation
Dominica-Delegate		
Dominica - Alternate		
Grenada-Delegate		
Grenada-Alternate		
Haiti-Delegate		
Haiti-Alternate		
Jamaica – Delegate		
Jamaica – Alternate		
Saint Lucia – Delegate		
Saint Lucia - Alternate		
Saint Vincent and the Grenadines – Delegate		
Saint Vincent and the Grenadines – Alternate		
CRFM Secretariat – Delegate		
CRFM Secretariat – Alternate		
Consultant-Delegate	Jimena Eyzaguirre	Team Leader and Climate Adaptation Expert, ESSA
Consultant-Alternate	Natascia Tamburello	Marine Systems Ecologist and Science Communications Expert, ESSA

Preliminary Calendar of Activities

Date	Milestone	Notes
2018		
First two weeks of June	Coordination on local activities in pilot study sites (DGroup)	Country members assist in making linkages to in-country stakeholder for consultations on the monitoring system, data collection for the KAP study and value chain analysis
June 19, 2018	Presentation on draft findings of the qualitative pathways of effects analysis on ecological impacts of climate change (Virtual meeting)	Pertains to Work Package 1: Assessment
August 9, 2018	Presentation on a draft stakeholder engagement and communications strategy (Virtual meeting)	Pertains to Work Package 3: Engagement and Communications
August 21, 2018	Presentation on early findings of the value chain analysis (Virtual meeting)	Pertains to Work Package 1: Assessment
Month of September	Skype interviews (one on one) on progress and lessons in implementing the Regional Strategy and Action Plan	Pertains to Work Package 4: Adaptation and disaster risk mainstreaming
October 16, 2018	Presentation on regional ecological modelling and national-scale summaries (Virtual meeting)	Pertains to Work Package 1: Assessment
Second week of November	Written update from Communications and Media Specialist on campaign roll-out (DGroup)	Pertains to Work Package 3: Engagement and Communications
December 4, 2018	Presentation on results of socio-economic impact assessment (Virtual meeting)	Pertains to Work Package 1: Assessment
2019		
Second week of January	Written update from Team Leader (DGroup)	
Second week of February	Written update from Communications and Media Specialist on campaign roll-out (DGroup)	Pertains to Work Package 3: Engagement and Communications
March 19, 2019	Presentation on draft monitoring framework (Virtual meeting)	Pertains to Work Package 2: Climate-Smart Monitoring System
April 16, 2019	Presentation on progress on analytical and monitoring tools	Pertains to Work Package 2: Climate-Smart Monitoring System
May 21, 2019	Guided discussion to develop a training program (Virtual meeting, subsequent feedback through DGroup)	Pertains to Work Package 2: Climate-Smart Monitoring System
Second week of June	Written update from Communications and Media Specialist on campaign roll-out (DGroup)	Pertains to Work Package 3: Engagement and Communications
July	No planned activity	
Second week of August	Written update from Team Leader (DGroup)	

Date	Milestone	Notes
September 17, 2019	Presentation on simple tools to monitor knowledge-attitudes-practice on climate-smart fisheries (Virtual meeting)	Pertains to Work Package 3: Engagement and Communications
October 22, 2019	Presentation on proposed draft updates to Regional Strategy and Action Plan (Virtual meeting)	Pertains to Work Package 4: Adaptation and disaster risk mainstreaming
November-December	Time for CRFM Secretariat and country members to review of final project outputs	The purpose is not to elicit feedback but to give Working Group members an opportunity to identify what parts of the research and recommendations they might be able to take forward
2020		
January 22, 2020	Guided discussion on action planning – What next? (Virtual meeting)	

APPENDIX 4 TO ANNEX III: SUMMARY OF MONITORING WORKSHEETS

What should be monitored? What tools are needed?

1. Are there specific high priority indicators that you would recommend be monitored?

Dominica	Sea surface temperature
Dominica	Ocean currents
Grenada	Weather parameters (rainfall, wind, sea conditions, etc.)
Grenada	Catch and effort, socio-economic information, catch trends by species
Grenada	Water quality, SST, currents, biochemical
Grenada	*Weather conditions (rainfall, wind, sea conditions etc.). Gaps are inability to estimate total catch, especially some species where secondary landing/fishing sites are left out and not sampled.*
Haiti	Production volume for the pelagic species and the high value coastal species like lobster and conch.
Haiti	Ocean temperature records and pH
Haiti	Fish size
Haiti	Species diversity
Haiti	Catching data
Haiti	Species diversity
Haiti	Fish size
Haiti	Habitat for relevant species
Haiti	Temperature records of ocean
Haiti	Eventually pH
Jamaica	Species distribution and abundance particular lobster and reef conch
Jamaica	Market demands
Jamaica	Market demands, species of commercial value, landings, export/import
Jamaica	*Monitor species distribution, abundance, species of commercial abundance and parrotfish, and market demand (local and international). Sometimes we delay opening a season because the market is not strong yet (e.g., tourism), or because price will be higher if they delay harvest against a quota.*
Saint Lucia	Size and length frequency of sampled fish landed
Saint Lucia	Biological assessment
St. Vincent & The Grenadines	Catch/landings by fish type, quantity, period, location landed

St. Vincent & The Grenadines	Weather conditions
St. Vincent & The Grenadines	Catch data, effort data, catch per unit of effort of fish landed.
St. Vincent & The Grenadines	*We have catch and effort data currently, but some issues with it. Sample size is problematic, too small, we also need to employ a different sampling strategy. We use random sampling, but we need an optimal sampling strategy to allocate the right amount of effort in the right places.*

2. What statistics are already being gathered in your country that would be relevant to the pathways we have discussed earlier in the workshop?

Dominica	Catch and effort data
Dominica	Vessel registration
Dominica	Fisher registration
Dominica	Ocean acidification data - kit deployed
Dominica	Fisheries industry census
Grenada	Meteorological
Grenada	Fisheries statistics - catch and effort, landings, registrations, exports
Grenada	NAWASA - some water quality parameters
Grenada	Household income
Haiti	Production volume from ocean fishery
Haiti	Active fisher population
Haiti	Fish species diversity
Haiti	Fisher numbers
Haiti	Fishes species diversity
Haiti	Global catch data
Jamaica	Catch and effort data
Jamaica	Landings, fleet types and characteristics
Jamaica	Export/imports - market destination
Jamaica	Catch and effort
Jamaica	Biological
Saint Lucia	Estimated fish landings (weight)
Saint Lucia	Ex-vessel prices

Saint Lucia	*We have a catch and effort data system, vessel licence and fisher registration systems, 2 fisheries industry census, information of hurricane impacts. We're collecting physical ocean variables too. We have catch and biological information, but we have no sampling plan, we need a sampling plan for representativeness of the data. We also need a vessel survey for vessels coming from outside of the system to fish (not licensed in St. Lucia). Would be useful to have an assessment system that incorporates ecological, social, and economic. Would be good to have stock assessments of some key species, e.g., tuna. We have starting data, but no stock assessments.*
St. Vincent & The Grenadines	Landings (fish) by fish type, quantity, period
St. Vincent & The Grenadines	Catch and effort of fish species landed

3. Are there opportunities to relatively easily gather relevant information from fishers, local communities, or other groups?

Dominica	Stakeholder meeting
Dominica	Interactions at landing sites
Grenada	There are data gaps due to limited capacity to collect data - not because the data is unavailable.
Haiti	Yes - are opportunities to work with local fishers etc.
Jamaica	Yes - legal instruments (schedule terms), landing logsheets from industrial members, extension services, data collection programme
Jamaica	Scheduled log forms, extension services, data collection programme
Saint Lucia	Yes, there are opportunities

4. Based in part on conceptual modelling discussions yesterday, what additional indicators would be most useful in detecting and quantifying climate change impacts?

Dominica	Socio-economic information
Grenada	Rate of recovery of ecosystems
Grenada	Measurement of the ability of fishers to adapt - vulnerability recovery index
Haiti	Fisher revenue
Haiti	Stock population for coastal species
Haiti	Maturation stage of fish species
Jamaica	Species biodiversity
Jamaica	Species biodiversity/mix, AGRRA Studies

Saint Lucia	Pelagic fisheries migration and distribution
Saint Lucia	Unusual ocean currents

5. What are the critical gaps in your current fisheries monitoring systems? What additional information would be most useful to you in managing important fisheries?

Dominica	Biological information (no sampling plan)
Dominica	Vessel frame survey
Dominica	*Critical gaps most important – age structure, age of maturity of pelagic species not understood. Unknown if we're fishing down the older cohorts, or if fish are smaller but still mature because of conditions and adaptation. Condition factor of the fish to be an indicator. Also, a lot of uncertainties about actualities of fishers and costs and revenues of fishing considering climate change and all the additional stressors.*
Grenada	Inability to estimate total catch especially of demersal species - secondary sites.
Haiti	There is no system that monitors the fisheries activities related to catch volume, season, maturation.
Haiti	*We are at a very basic level of monitoring; we need to better monitor catch. We have global data on weight, capture, but not broken out by species or size (echoed from other countries). For individual species, we have no idea how much we catch per year, so hard or impossible to do stock assessments. We are also unsure about the stage of maturation. We also have no idea of stock size of the key fisheries species, e.g., lobster.*
Jamaica	Habitat maps
Jamaica	Adequate funds
Jamaica	Revised sampling frame to calculate production
Jamaica	Funds
Jamaica	Habitat maps
Saint Lucia	Maturity age of pelagic species
Saint Lucia	Actual income earnings of fishers, as well as costs/expenses.
Saint Lucia	Productive fishing grounds
Saint Lucia	Health and status of coral, seagrass, and mangrove habitats
St. Vincent & The Grenadines	To increase sampling size in data gathering
St. Vincent & The Grenadines	Costs involved in fishing industry
St. Vincent & The Grenadines	Need for biological data collection
St. Vincent & The Grenadines	Need to increase sample size of current catch and effort data collection system

6. Are there specific models, tools, assessments, or analyses that would be useful to your country in making fisheries related management and policy decisions?

Dominica	Assessments which incorporate ecological and socio-economic factors
Dominica	Stock assessment for the main fisheries
Haiti	The baseline on Haiti fisheries should be done first and monitored for the most high value species in the coastal areas and for the pelagic species.
Jamaica	Mapping software e.g. GIS
Jamaica	GIS Software
Saint Lucia	Determining the sizes/maturity of fish species
Saint Lucia	Management effectiveness of fisheries sector

Existing Systems – Tools and databases that could improve climate-smart management and policy decisions

National Systems

7. For the current fisheries statistics system in your country: what are its strengths and where could it be improved? Have you identified any specific gaps or concerns? Are there current plans for new capabilities?

Dominica	Representation of island wide production is good
Dominica	Captures by species could be improved
Dominica	Concerns: Sampling method coverage
Dominica	Yes, there are plans to create a general agriculture and fisheries database
Grenada	Comprehensive data collection and management system
Haiti	There is no statistics system
Haiti	There is a plan to set up a system before the end of 2018. This needs to be started.
Haiti	It should be improved through monitoring system
Haiti	It should be systematic for the whole community
Haiti	There is a new developing plan to handle and manage fishery data
Jamaica	Strengths: User friendly software easily accessible MS Office Excel
Jamaica	Potential improvements/gaps: Prone to errors and as such a more robust system is required for large data.
Jamaica	5-year plan for Fish Link…
Jamaica	Available software - MS Office Suite. Prone to errors, need a more robust database

Jamaica	FISHLINK - 2018-2023 for Jamaica
Jamaica	Needs to be user friendly
Saint Lucia	Capture of real time data
Saint Lucia	Inability to collect data from all vessels throughout the month
Saint Lucia	Socio-economic impacts/value of thee sector
Saint Lucia	Current system is DOS based
St. Vincent & The Grenadines	Data on landings, available export and import data
St. Vincent & The Grenadines	However, sample collection is done for fish landings may need to increase sample size
St. Vincent & The Grenadines	Sampling strategy but full census on sampling days
St. Vincent & The Grenadines	Need to increase sampling days
St. Vincent & The Grenadines	Need to use an optimal strategy (Neyman) for sampling. Current method appears random.
St. Vincent & The Grenadines	Cache of one central database
St. Vincent & The Grenadines	More staff needs to be trained in sampling strategies CFAO guidelines

8. What are your capabilities for managing databases and spatial data? Numbers of technical staff? What tools do you use?

Dominica	One technical staff
Dominica	Access database
Grenada	Chronic capacity deficiency - especially human resources
Haiti	The fisheries department does not have experience managing statistical data but software is available and with training will be able to handle a spatial database.
Haiti	There are 12 technical staff
Haiti	We have lack of software or learning experience to manage data. But once software will be available we will easily handle because we have good technical staff in fisheries sector.
Jamaica	Technical staff: 2
Jamaica	Capabilities: Training in MS Suite and ArcGIS
Jamaica	Use: ArcGIS, Excel, Access
Jamaica	2 technical staff with training in MS Office - Excel and Access
Jamaica	ArcGIS, Access, Excel
Saint Lucia	Very limited with only one person on staff who is responsible for data analysis. However, her skills are not suited to effectively manage fisheries databases or spatial data.
Saint Lucia	Interagency collaboration is required but sometimes a challenge in getting full commitment

St. Vincent & The Grenadines	Presently 2 persons manage data using Excel
St. Vincent & The Grenadines	There are 6 data collectors that support the system by providing data
St. Vincent & The Grenadines	Persons managing data
St. Vincent & The Grenadines	Data stored in Microsoft Excel
St. Vincent & The Grenadines	6 data collectors but they are not involved in data management.

Regional Systems

9. What other organizations do you think should be involved at a regional level that could provide data and/or data management and analysis capabilities?

Dominica	CRFM
Grenada	UWI
Grenada	SGU
Grenada	FAO
Grenada	IMA
Haiti	CRFM, FAO, IICAT
Haiti	Ministry of Environment
Haiti	Combined data from NGO
Haiti	CNIGS
Haiti	CIAT – Inter-ministry Council for Land Management
Jamaica	WECAFC/FIRMS /FAO – ARTFISH
Jamaica	CRFM
Jamaica	CRFM, FAO (FIRMS), WECAFC
Saint Lucia	University of the West Indies
Saint Lucia	Caribbean Network of Fisherfolk Organization

10. Are there existing systems that could be enhanced or redeveloped to be used for climate smart monitoring such as CARIFIS? Or new systems?

Haiti	No existing systems
Haiti	Probably CARI SAT. It's like satellite global data for the Caribbean. It will be very useful for catch ocean data or marine environmental, mainly pelagic ecosystem and coastal.
Jamaica	CARIFIS - needs to be revised
Jamaica	FISHLINK may have some promise

Jamaica	ARTFISH (FAO)
Jamaica	*We have a LOT of fisheries data, we were using CARIFIS, it was a useful tool, but our needs outstripped it and it crashed, so we went to our own system. Again, the issue was sustainability. Updating CARIFIS to a system that's easier to adapt (modern programming) would be very helpful. Also wasn't very user friendly. Some people still use it a bit. Some people tried to use it but it wasn't compatible with in-country systems being used.*
Saint Lucia	CARIFIS - needs to be supported
All	*The potential to revamp CARIFIS is not off the table*
All	*Fisherfolk representatives, having been exposed to another PPCR CRFM output FEWER (https://today.caricom.org/tag/fisheries-early-warning-and-emergency-response-fewer-system/) and because of the nature of their activities are keen on real-time (or near real time) practical tools.*

Implementation Options

11. Should a climate smart fisheries monitoring system be set up with: (A) a regional/centralized system; or (B) Each country having their own database; or (C) a mixture?

Dominica	B - own database is preferable
Grenada	B - own database
Haiti	C - a mixture of regional systems and a local country specific database.
Jamaica	B - own database - but who will sustain after the project ends?
Jamaica	B - own database is preferable
Jamaica	*Most countries want their OWN database, because they feel like they could sustain it better after completion of the project. But if the separate systems are linked that would facilitate sharing, often get data requests to share. Try to develop local systems which have common fields, and are linked, to facilitate sharing. A data sharing policy is lacking in our countries and there are data sharing and privacy issues. Until we have a data sharing policy, it will be hard to develop a centralized system, we'd like to do that, but we need groundwork to do that in the form of a policy.*
Saint Lucia	C - a mixture of regional systems and a local country specific database.
St. Vincent & The Grenadines	B - own database is preferable
St. Vincent & The Grenadines	B - own database is preferable

12. What are the biggest barriers in your country to maintaining and supporting databases and tools – either regionally or nationally?

Dominica	Technical expertise
Dominica	Appropriate tools and equipment
Grenada	Low investment in data collection, management, and analysis
Haiti	Collecting data from fishermen. We need human resources and logistics to implement the system.
Jamaica	Fund allocation
Jamaica	Technical support
Jamaica	Funds and technical support
Saint Lucia	Expertise
Saint Lucia	Infrastructure
Saint Lucia	Reliable sources
Saint Lucia	Converting data to relevant/user friendly information
St. Vincent & The Grenadines	Lack of appropriate software (statistical)
St. Vincent & The Grenadines	Need more staff and training in analysis
St. Vincent & The Grenadines	Lack of appropriate software
St. Vincent & The Grenadines	Need for more data management staff in the fisheries division
St. Vincent & The Grenadines	Need for more staff training in data management in the fisheries division
All	*With regard to the monitoring system and supporting databases were: sustainability, capacity, practicality and ability to accommodate regional differences*

13. Who should manage a regional system if one were to be developed? How should it be supported?

Dominica	CRFM
Grenada	A CARICOM agency
Haiti	The country that has highly qualified human resources and is supported to manage the system, but each country has to get access to the system to enter its own data.
Jamaica	Who should manage – CRFM
Jamaica	How - Member states funding, external donors who rely on the statistics generated, remote assistance, staff anywhere.
Jamaica	CRFM should manage

Jamaica	Member states should support along with eternal orgs that require the data. Remote assistance technical support
Saint Lucia	CRFM
Saint Lucia	Support from UWI, CNFO

14. What constraints are there in sharing data related to fisheries with other countries in the region? Who should be able to access and view fisheries data and analyses?

Dominica	Data sharing already exists through CRFM
Dominica	Data once accurately analysed should be accessible to all
Grenada	Getting approval.
Haiti	No constraints, if the system is implemented the data can easily be shared to other countries.
Jamaica	Data sharing policy not developed due to sensitive data
Jamaica	Data sharing policy agreements should be in place due to proprietary nature of sensitive data.
Saint Lucia	Type of data currently collected don't meet the needs of other countries or agencies in the region
Saint Lucia	All interested
St. Vincent & The Grenadines	Each country can decide what information is restricted
St. Vincent & The Grenadines	Information should be shared. However, a country may decide which information is to be shared.
Grenada	Fisheries managers, researchers, fisher organizations
Haiti	The monitoring and evaluation fisheries officer, government, and private sector should be able to access and view fisheries data and analyses.
Jamaica	CRFM and the member states.
Jamaica	All CARICOM member countries in the CRFM with necessary authorized access.

Users, Training and Staffing needs

15. Who would be the users of databases and tools developed in this project?

Dominica	Technical staff responsible for data and statistics
Grenada	Government agencies
Grenada	Some NGOs
Grenada	Fisher organizations
Haiti	Private sector, fishermen, Policy makers

Haiti	Government for public policy
Haiti	NGO to know where to act and how
Haiti	Private sector to know their options
Jamaica	Data unit staff, fisheries officers, director of Marine Branch
Jamaica	Data unit staff and fisheries officers, directors of Aquaculture Branch and Marine Branch
Saint Lucia	Government
Saint Lucia	Fisherfolk
Saint Lucia	NGO
Saint Lucia	Consumer market
St. Vincent & The Grenadines	Fisheries departments
St. Vincent & The Grenadines	Planning and policy makers
St. Vincent & The Grenadines	Fisheries division
St. Vincent & The Grenadines	Uncertain who else, more information as project progresses

16. Who should be trained on (1) analytical tools and (2) monitoring and database systems that are developed as part of this project?

Dominica	Technical staff responsible for data and statistics
Grenada	Fisheries technical staff, government natural management agency staff, fisher organizations where there is capacity, some NGOs
Haiti	People who are working in fisheries department
Haiti	Government staff like the technical staff at the fisheries department. Just to ensure good governance.
Jamaica	Data unit manager, fisheries officers, technical staff
Jamaica	Data unit staff (2)
Jamaica	Analytical tool training: Data unit manager and Fisheries/Technical officers
Jamaica	Monitoring and database systems: Data unit staff
Saint Lucia	Fisheries officers
Saint Lucia	IT Specialist
St. Vincent & The Grenadines	Members of the fisheries biology and research unit, public education unit, conservation unit. Others? Will see as project progresses.
St. Vincent & The Grenadines	Other government - will see as project progresses

Next Steps

17. In the coming months we would like to have discussions on technical issues of fisheries and environmental data management. Who would you suggest we talk with?

Dominica	Technical staff with specific responsibility for data and statistics
Grenada	Permanent secretary of the relevant ministry.
Haiti	Director of fisheries and aquaculture department, Mr. Badio Jean Robert or Mr. Roger Charles, Monitoring and evaluation officer for Artisanal fisheries development programme.
Haiti	Jean Robert Badio - Dean of fisheries department of Haiti.
Jamaica	Fisheries division
Jamaica	Natural environment and planning agency
Jamaica	UWI - Center for Marine Studies
Jamaica	Institute of Jamaica
Jamaica	LICJ - Land Information Council of Jamaica
Jamaica	Fisheries division
Jamaica	National Environment and Planning Agency
Jamaica	UWI - Center for Marine Studies @ Mona
Jamaica	Ministry of Industry, Community Agriculture, and Fisheries
Jamaica	Information and Communication Technology Unit.
Saint Lucia	Dept of Fisheries
Saint Lucia	Dept of Statistics
Saint Lucia	Economic Development
St. Vincent & The Grenadines	Fisheries division
St. Vincent & The Grenadines	Contact the chief fisheries officer - Mrs. Jennifer Cruickshank-Howard.

APPENDIX 5 TO ANNEX III: WORKSHOP PRESS RELEASE

PRESS RELEASE - FOR IMMEDIATE RELEASE

Kingstown, Thursday, 26 April 2018 – (CRFM)

Regional Project Working to Make Caribbean Fisheries Climate-Smart
Fisheries experts from Dominica, Grenada, Haiti, Jamaica, Saint Lucia and Saint Vincent and the Grenadines met in Kingstown, St Vincent on April 25 and 26 to explore options for a climate-smart fisheries monitoring system and a related fisheries and environment database.

The experts met at a two-day workshop organised by the Caribbean Regional Fisheries Mechanism (CRFM) to support the roll out of the Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System project. The project is an initiative under the Regional Track of the Caribbean Pilot Programme for Climate Resilience (PPCR), funded by the Climate Investment Funds through the Inter-American Development Bank, and managed by the University of the West Indies' Mona Office for Research and Innovation.

This data-driven project under the PPCR recognises that Caribbean fisheries are under serious threat due to climate change, and focuses on information strengthening to facilitate climate smart planning for the sector.

Across the region, coastal erosion is compromising important fish landing beach sites. Rising sea levels and more intense storms are causing major damage to fish habitats and reducing fishery access and assets. Recognising the complexity of these problems, and the need for a comprehensive response and greater collaboration among stakeholders in the sector, the workshop focused on developing a shared understanding of the impact of climate change on the ecological and socio-economic components of fisheries systems across the Caribbean. This shared understanding is an important first step in supporting participants to explore options for a climate-smart fisheries monitoring system and related fisheries and environment database.

Jullan Defoe, Senior Fisheries Officer from Dominica said data was critical for fisheries management: "After the devastation of Hurricane Maria, Dominica discovered that there was a serious data void. The gaps in the availability of relevant data and information in some instances have hampered strategic interventions in the emergency recovery phase. The most critical outcome of this project will be a comprehensive ecological assessment. This is something that Dominica absolutely needs in order to recover, and more so as we aim to become the first climate resilient country in the world."

Over the two-day event, participants worked to select pilot study sites for local project activities and discussed the development of a climate-smart monitoring system. They also examined options for strengthening communication to improve knowledge, awareness and practices for climate adaptation and disaster risk reduction responses in the Caribbean fisheries sector. The workshop took steps towards establishing a CRFM PPCR Project Working Group, to support work under the Fisheries sub-component of the Regional PPCR.

Dr. Susan Singh-Renton, Deputy Executive Director of the CRFM Secretariat, underscored the importance of having this project working group: "The Caribbean faces a number of common challenges, and so it makes sense for us to work together as a group. The Working Group will allow experts who have good local knowledge to commit to the project for a period of two years…and as the project evolves, members will have opportunities to learn about the new methods and tools required for climate smart fisheries monitoring and management."

The CRFM is co-implementing partner for the Fisheries Sub Component of the Regional PPCR.

PHOTO Caption:
Workshop participants map the pathways of climate change impact on ecological and socio-economic components of three fisheries systems (reef, mangrove / seagrass and pelagic ecosystems) as a part of activities at the two-day PPCR Caribbean fisheries workshop in Kingstown, St Vincent.

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Facebook: http://www.facebook.com/CarFisheries and
Twitter: https://twitter.com/CaribFisheries

ANNEX IV: PILOT STUDY SITES

Pilot study sites

The Terms of Reference for the Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System project ("the project") called for the selection of and focus on "pilot study sites". Based on Project Team discussions with the CRFM Secretariat and budgetary considerations, we propose to undertake localized project activities at up to three pilot sites. This memo describes the purpose of pilot study sites, selection criteria, evaluation of the potential sites, and recommendations for site selection. Based on the selection criteria and evaluation, the three proposed sites are (1) Montego Bay (Jamaica); (2) Kingstown (St Vincent and the Grenadines) and (3) Roseau (Dominica).

Purpose

Pilot study sites within the six countries with Pilot Program on Climate Resilience initiatives serve three purposes. First, they are areas on which to test the implementation of the eventual monitoring system. Second, the focus on pilot study sites provides a practical bounding for project activities pertaining to assessment (data collection for the value chain analysis) and communications (target audiences for the Knowledge-Attitudes-Practice study). As discussed in the Inception Report, layering project activities in the same three pilot study sites provides efficiencies, continuity, and greater potential to usefully integrate project components and promote sustainability of project results. Third, although the scope for primary data collection within the project parameters is limited, strategic data collection at the site level will yield valuable information on climate-related risks and appropriate policy responses from the local to national levels.

Criteria

In selecting pilot project sites "country make up" was a first consideration. St Vincent and the Grenadines, Saint Lucia, Dominica and Grenada are in the Lesser Antilles / Eastern Caribbean and are a part of the Organization of Eastern Caribbean States (OECS). These countries share a number of similarities that can be attributed to their geographic proximity, and socio-political, historical and linguistic background. Jamaica and Haiti are larger islands in the Western Caribbean, with Jamaica sharing some of the socio-political, historical and linguistic background of the OECS countries and Haiti presenting language differences (French/ Creole) and known deficiencies in official data. Given that we are limited to three pilot study sites to be selected from two countries in the Western sub-region and four countries in the Eastern Caribbean, it is reasonable to select one site in the Western Caribbean and two in the Eastern Caribbean.

Further to this first consideration, we used the following selection criteria to help us identify sites with the potential to maximize learning:

1. Representativeness (critical habitats - mangrove/seagrass ecosystems, reliance on fishing, etc.);
2. Strong coupling of ecological and social systems to understand feedbacks;
3. Ecological connectivity (stocks, habitats, inshore and/or offshore migration, etc.);
4. High contribution of / reliance on fisheries to food security, commodity trade, livelihoods, etc.;
5. Vulnerable of coastal infrastructure and assets (e.g. port, fishing wharf, processing plant);
6. Level of stakeholder interest in climate resilience;
7. An environment that is conducive to undertaking field research / engagement in a way that is socially inclusive and supportive by the state and local authorities;
8. Potential access to a wide range of knowledge holders for interview / focus group (fisher folk, fishing cooperatives, fish vendors, fish processors, fisheries officers, policy makers);
9. Data availability for assessment purposes; and,
10. Accessibility for field work (transportation, safety and security, cost effective, etc.).

Options

The following table gives a score for the various criteria (high, medium and low), based on the Food and Agriculture Organization (FAO) country profiles[i] and a preliminary review of the literature.[ii] (Table 1).

Country and site location		Selection criteria										Total score
		Representation	Coupling	Connectivity	Reliance	Vulnerability	Interests	Conducive	Knowledge	Data	Access	
Jamaica	Montego Bay	3	3	3	3	3	3	3	3	2	1	**27**
	Portland Bight	2	2	3	2	3	3	3	2	2	2	25
Haiti	Port-au-Prince	2	2	2	3	3	2	1	2	1	1	19
Saint Vincent and the Grenadines	Kingstown	3	3	3	3	3	3	3	3	2	3	**28**
Saint Lucia	Soufriere	3	3	3	2	2	2	2	2	2	3	24
Dominica	Roseau	2	3	2	3	3	3	2	2	2	3	**25**
Grenada	Carriacou	3	2	1	3	2	2	2	3	2	2	22

Table 1: Candidate pilot study sites and scores against 10 criteria (where 1 is low and 3 is high)

Two summary charts are also provided, one with some biophysical features (Figure 1), and the other with socio-economic attributes (Figure 2).

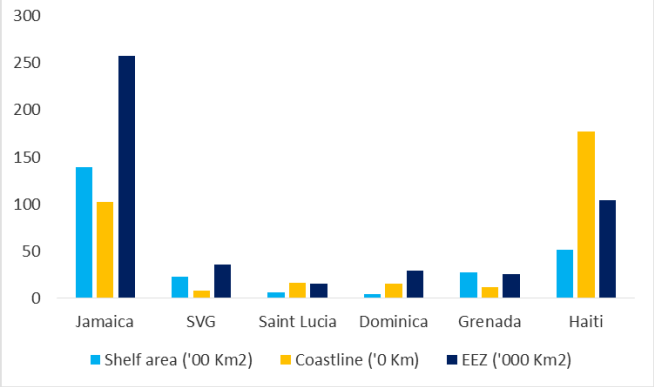

Figure 1: Non-variable geophysical features of participating countries (Source: FAO)

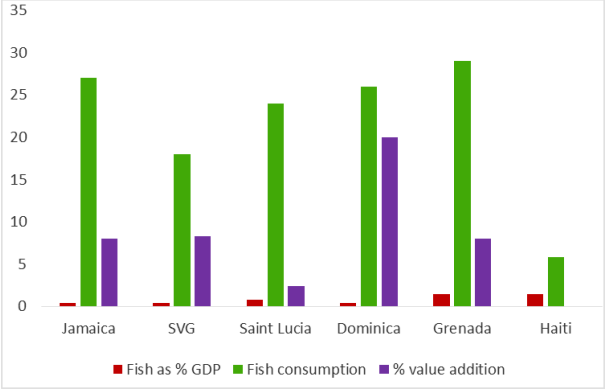

Figure 2: Varying socio-economic attributes of participating countries (Source: FAO)

Jamaica has the largest shelf area and economic exclusion zone of the six countries, whereas Haiti has the longest coastline. Among Eastern Caribbean states St Vincent and the Grenadines and Grenada present similar characteristics in terms of shelf area, areal extent of the economic exclusion zone and coastline length. With regards to socio-economic attributes, the fisheries sector is a greater contributor to gross domestic product in Haiti than in Jamaica. However, levels of fish consumption and value addition are significantly greater in Jamaica than in Haiti. Within the Eastern Caribbean, fish consumption and sectoral contribution to GDP are highest in Grenada, with value addition being most significant in Dominica.

Recommendations

As shown in Table 1, the top-ranked sites of interest are **Montego Bay** in Jamaica; **Kingstown** in SVG; and **Roseau** in Dominica.

Montego Bay in Jamaica is the top-ranked site in the Western Caribbean and we recommend undertaking project activities in that site for the following reasons:

- Montego Bay is highly coupled, with Marine Protected Area (MPA) and mangrove ecosystem linkages and reliance of seafood for both local consumption and export markets. Sufficient secondary data exist. There is strong stakeholder interest in climate change, not to mention the availability of sea-level rise and loss and damage estimates for coastal infrastructure. In addition, the Project Team has access to institutional and logistical support in Jamaica, since two team members are based there (including a professor at the University of West Indies, Mona Campus), as is the Project's executing agency (the Mona Office for Research and Innovation at the University of West Indies).
- In Haiti, reliance on fishery resources is high, owing to the strong connectivity to the reefs and vulnerability of the sector's infrastructure assets is also high. However, most of the management measures are not operational, due to capacity constraints and declining health of the reefs. There is also a growing aquaculture industry, which decouples marine social-ecological connectivity and places more reliance of fish farming mostly tilapia. Data availability is a known constraint.

Within the Eastern Caribbean, we recommend Kingstown and Roseau as the pilot study sites in which to undertake project activities for the following reasons:

- Kingstown (St Vincent and the Grenadines) is a good starting point for the socio-economic assessment as more than 50% of the national catch is marketed through the Kingstown Market Complex, a modern facility and processing hub for regional exports and global trade. There is also a strong inter-regional fish trade with most of the catch exported fresh to Martinique. This site scores highly against selection criteria of representativeness, connectivity and coupling, as does Soufriere in Saint Lucia. In Kingstown, however, the Project Team can count on additional institutional support from the CRFM Secretariat.
- Roseau (Dominica) is a favoured candidate site due to the processing and trade dimensions and the potential to explore livelihood synergies within that context. The key marine ecological reserves, such as Scott's Head, require travel by car but the travel distances are manageable and do not present challenges to conducting the work. Taking a closer look at Dominica in general has the potential to yield important lessons on assessment needs, data and monitoring requirements to enable the sector's preparedness for, response and recovery from major hurricane devastation. Dominica has also committed to becoming the world's first climate resilient nation, which means that interest among stakeholders is high, especially in the aftermath of the serious damage caused by Hurricane Maria.

Endnotes

[i] http://www.fao.org/fishery/countryprofiles/search/en

[ii] This includes:

CMEP (2017) Caribbean Marine Climate Change Report Card 2017. (Eds. Paul Buckley, Bryony Townhill, Ulric Trotz, Keith Nichols, Peter A. Murray, Chantalle Clarke-Samuels., Ann Gordon, Michael Taylor). Commonwealth Marine Economies Programme, 12 pp.

CRFM, 2013. McConney, P., J. Charlery, M. Pena. Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture in the Caribbean Region. Volume 1 – Assessment Report. CRFM Technical & Advisory Document, No. 2013 / 8. 93pp.

FAO (2013). Climate change adaptation in fisheries and aquaculture – compilation of initial examples. Fisheries and Aquaculture Circular No. 1088. Rome, FAO. 34pp.

GIZ. 2015. Loss and damage in the Caribbean: Climate change realities in Small Island Developing States. A study commissioned by the Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage). GIZ, Eschborn.

Monnereau, I. and Oxenford, H. A. (2017). Impacts of Climate Change on Fisheries in Coastal and Marine Environments of Caribbean Small Island Developing States (SIDS). Science Review 2017: pp 124-154.

The CRFM is an inter-governmental organization whose mission is to “Promote and facilitate the responsible utilization of the region’s fisheries and other aquatic resources for the economic and social benefits of the current and future population of the region”. The CRFM consists of three bodies – the Ministerial Council, the Caribbean Fisheries Forum and the CRFM Secretariat.

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