Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System

Report of the Regional Planning Workshop (Kingstown, 25-26 April 2018)

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Prepared for:

The University of the West Indies, Mona, and the Caribbean Regional Fisheries Mechanism

Contact:

Ms. Jimena Eyzaguirre, International Team Director, ESSA Technologies Ltd.

jeyzaguirre@essa.com

+1.613.798.1300 x 5

Report of the Regional Planning Workshop of the Caribbean PPCR Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System project, Kingstown, St. Vincent and the Grenadines, 25-26 April 2018. Contributors: R. Boyd, W. Cheung, J. Eyzaguirre, A.G. Gardiner, A. Khan, G., Reygondeau, N. Tamburello, C. Wabnitz and T. Webb.

Cover Photo: N. Tamburello, Fish Landing Site in Kingstown, St. Vincent, 2018

ESSA Technologies Ltd.
Vancouver, BC Canada V6H 3H4
www.essa.com

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About this report

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), Blanc Moramade (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)

1. 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

1. 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.

2. 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.

3. 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.*

4. 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 Annex 1; the workshop agenda is in Annex 2.

5. 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.

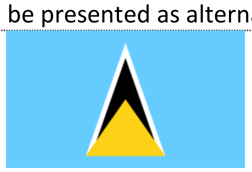
What I hope we achieve is to enhance my knowledge of the ecological impacts of climate change on our fisheries system. Because climate change does affect what I do (fishing) on a daily basis. When I get back I hope to share with my organization what I've learned. What I realize is a lot of fishers in 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.

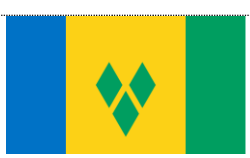
Jamaica: What I want to see is at the end how we can pull all these components and disciplines together and the sustainability of this project after the completion of this project, hoping to get something lasting considering all our data limitations, needs, and wants, and that the models we present are 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

6. 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.

7. 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.

Ecological modelling used in the project

8. 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.[1] 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.

9. 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.

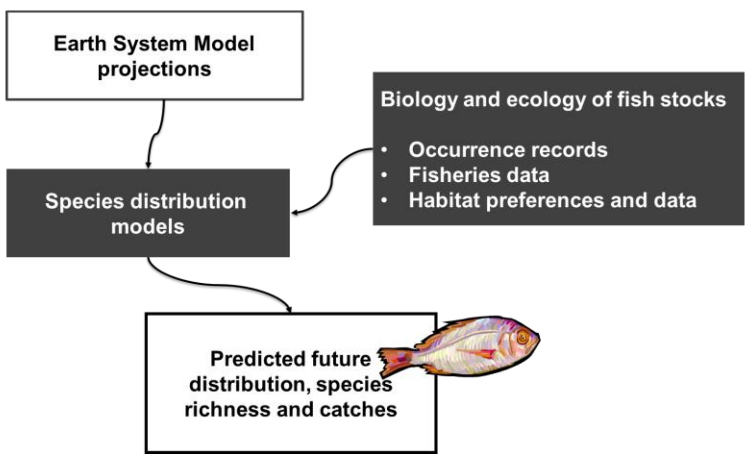


Figure 2: Ecological modelling framework (simplified)

10. 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.

[1] 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).

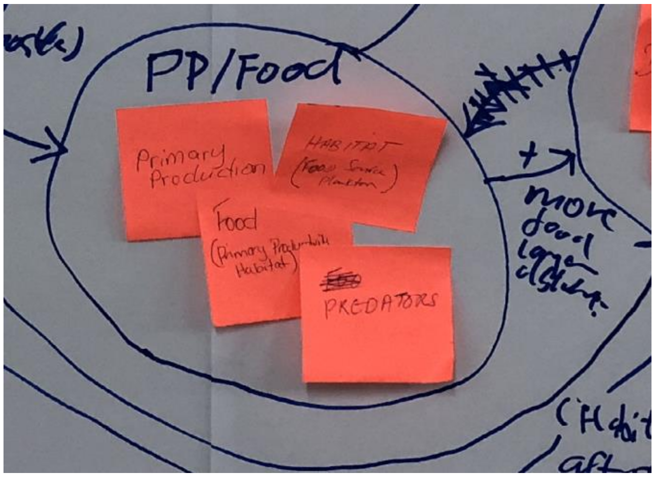
- How modelling results can inform decisions - Modelling results can help countries prepare their fisheries for changes, including new species and fisheries opportunities for some northern Caribbean countries, transition to offshore fisheries for countries with larger continental shelves to both follow 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.

11. 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 components. 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.

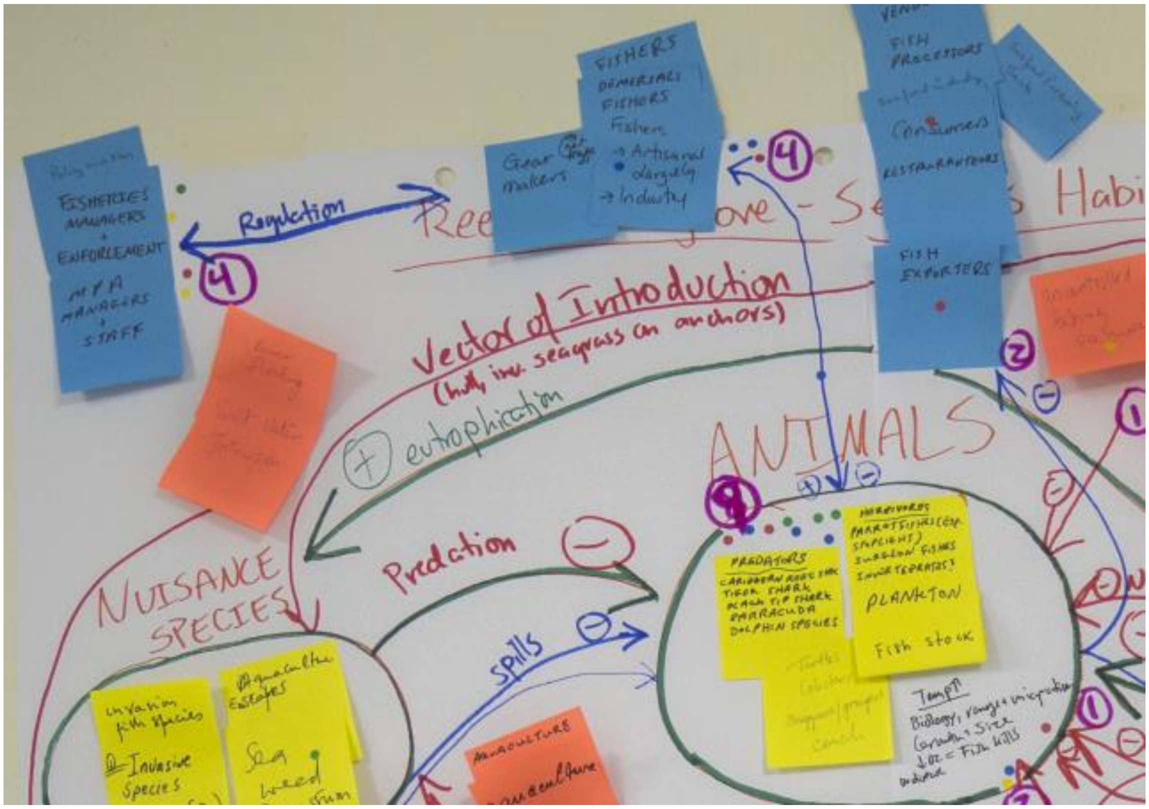
The developed conceptual models of the two ecosystems were then shared with all workshop participants (Figure 3)


PP/Food
Primary Production
HABITAT
Food
PREDATORS
more

A


O_2
Temperature
Physical
habitat
Current
pattern
Extreme
weather
events
Chemical

B



Regulation
Vector of Introduction
eutrophication
ANIMALS
Predation
NUISANCE SPECIES
spills
PREDATORS
PLANKTON
Fish stock
FISHERS
Gear makers
FISHERIES MANAGERS
ENFORCEMENT
FISH EXPORTERS
Consumers
RESTAURANTS
Invasive Species
Sea weed
AQUACULTURE

C

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

12. 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.

13. 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 Annex 3).

Hopes and concerns for the project

14. 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.
15. 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

16. 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*.

17. Ahmed first provided a primer on value chains. Value chains are a research approach that has emerged to address socio-economic and livelihood vulnerabilities.[2] The approach is especially applicable to fisheries, as seafood is highly perishable with higher levels of post-harvest spoilage than other agri-commodities.[3] 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.[4] 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)[5], not to mention the need to contend with both climate and non-climate factors affecting the resource base.[6]

    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[7]; in addition to price mark-up across seafood actors[8], as well as conceptual, facilitating a visual display of flows of products and distribution outlets.[9]

18. 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.

19. 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*

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

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

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

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

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

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

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

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

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

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.
- 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.

20. 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.
21. 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.
22. 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.

Defining a climate-smart fisheries monitoring system

23. 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.
24. Workshop participants provided feedback on the monitoring system through the use of worksheets 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.

25. 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

26. 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

27. 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.

28. 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.

29. 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 Annex 4) 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.

30. 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.

31. 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.

32. 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

33. 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.

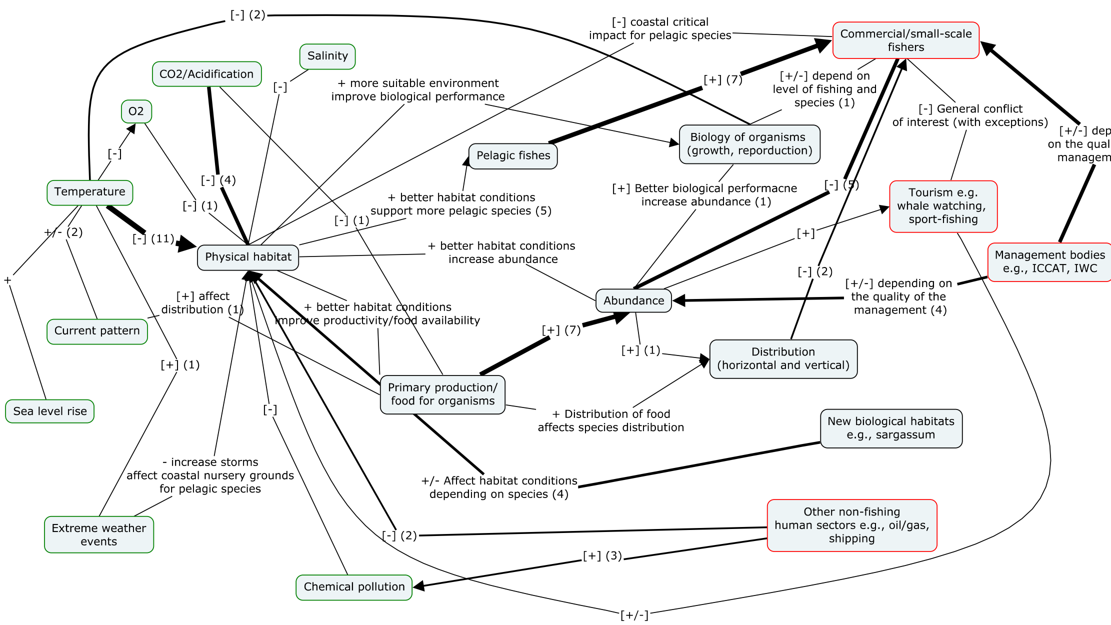
2. Ecological assessment

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

34. 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

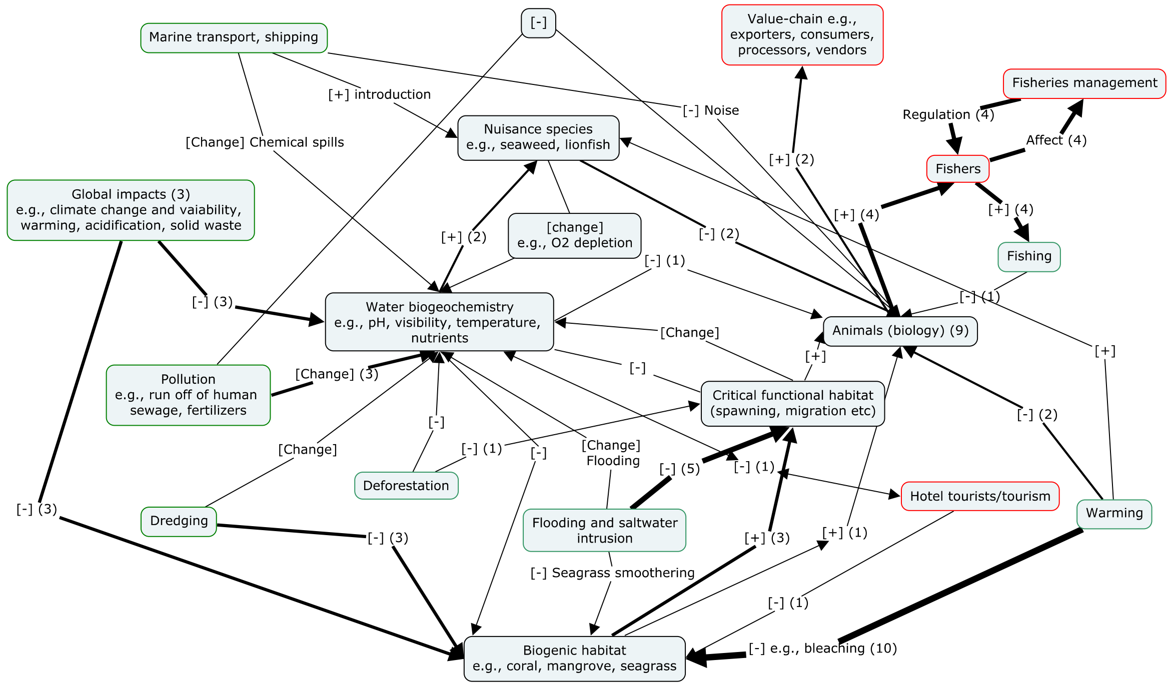


Figure 5: Conceptual models of the (A) pelagic ecosystem and (B) seagrass-mangrove-coral reef ecosystem visualized using Cmaptool. Boxes represent the biophysical components (black outline), environmental drivers (green outline) and human components (red outline) of the ecosystems. The arrows represent 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.

35. 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.

36. 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.

37. 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

38. 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

39. 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 6). 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).

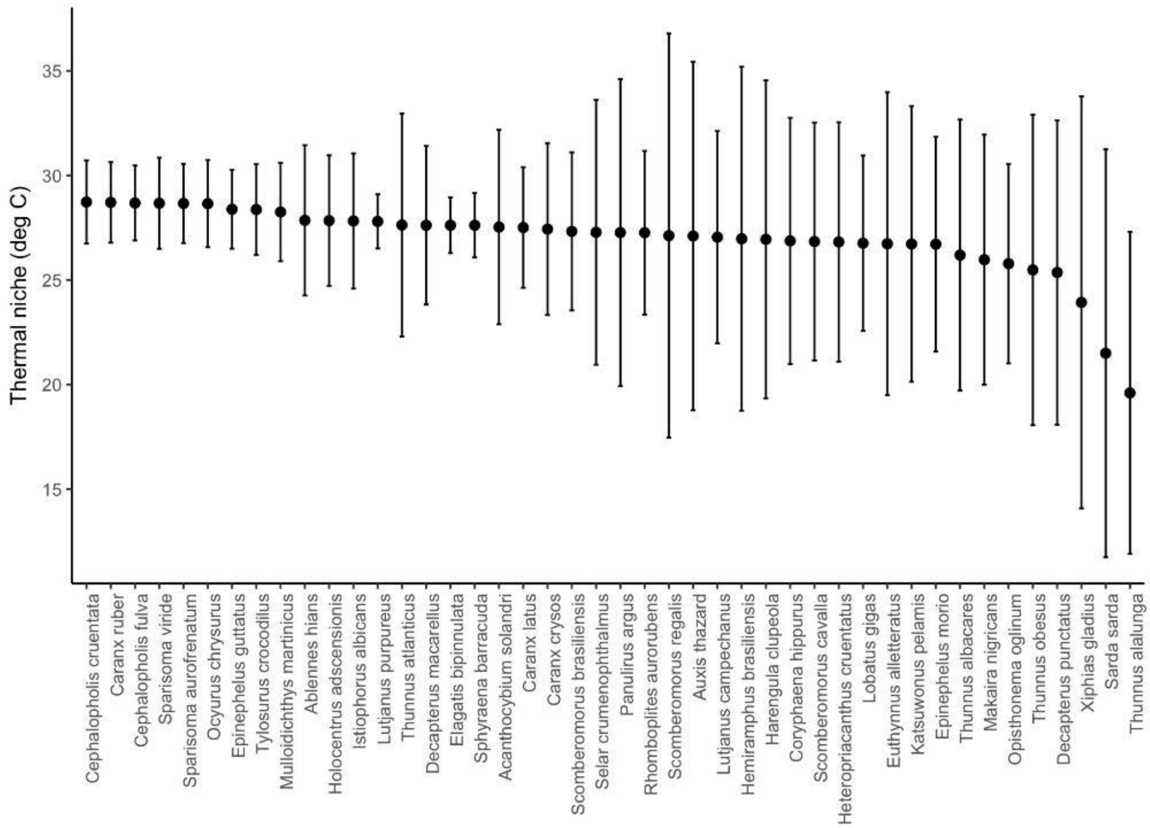


Figure 6: The mean thermal niche (black dots) and the breadth of the thermal niche (vertical lines) of the selected priority species.

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

40. 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[10] and covers the following themes:

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

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[10] 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.

41. 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

42. 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.[11] 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[12] and projects and programs implemented.[13]. The UNDP/GEF project[14] 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.[15,]

43. 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, 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*).[16]

44. 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.

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[11] 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.

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

[13] 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.

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

[15] 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.

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

HARVEST STAGE

45. 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*."

46. 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.

47. 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.

48. 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.

49. 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.

50. 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

51. 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.

52. 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.

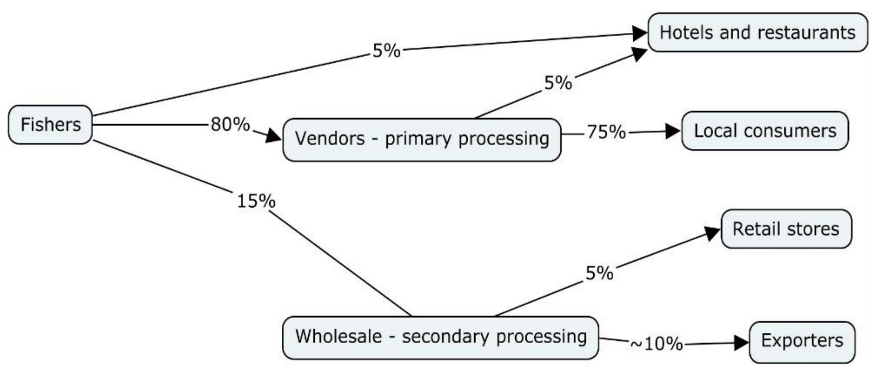

Figure 7: Schematic flow of average annual seafood by volume across the value chain (St Vincent and the Grenadines)

53. 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.

54. 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

55. 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

56. 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.

57. 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 Sargassam. 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.

58. 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.

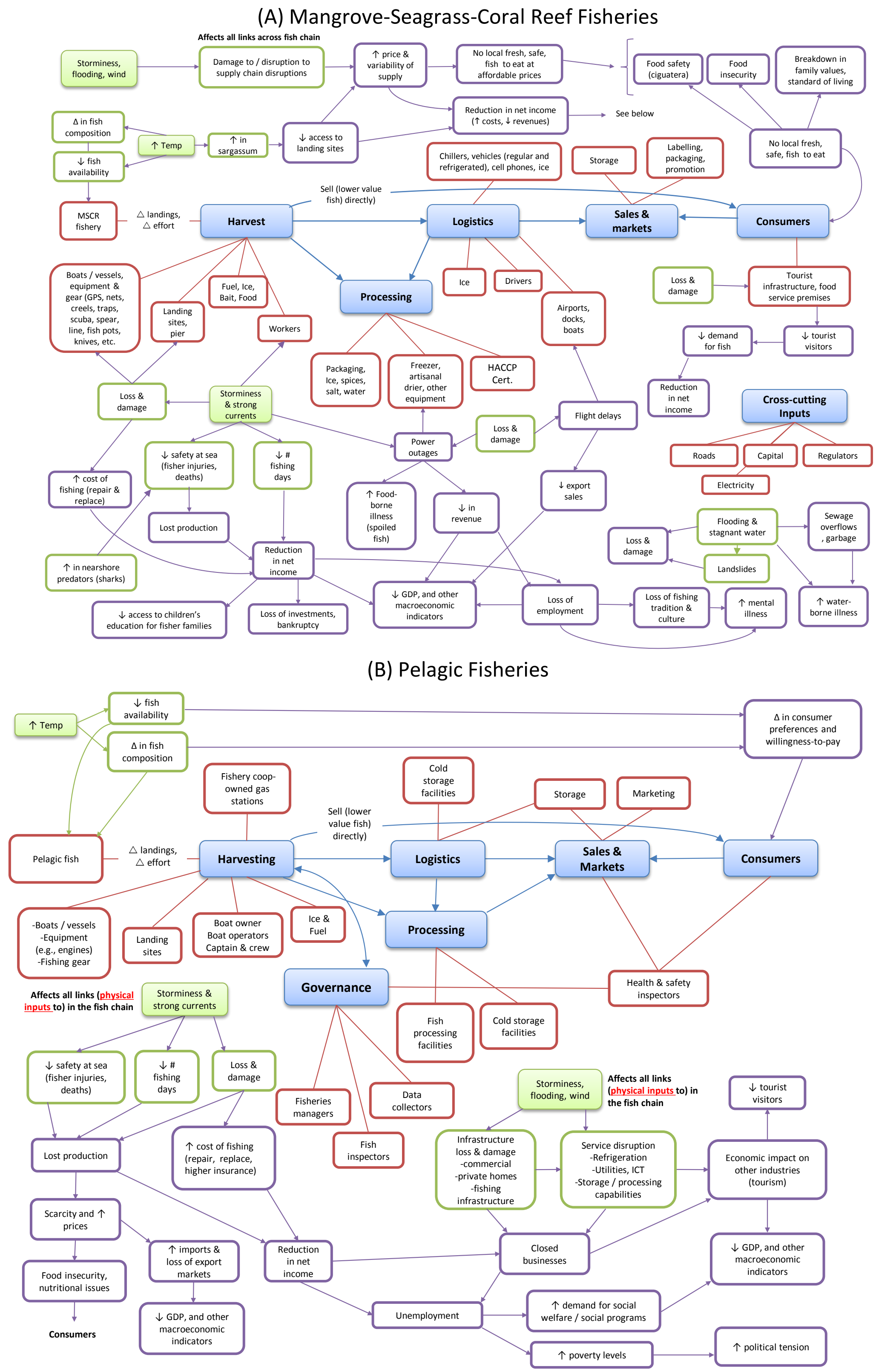

Figure 8: Conceptual models of the (A) seagrass-mangrove-coral reef fisheries and (B) pelagic fisheries visualized using PowerPoint. Blue shaded boxes represent the key fisheries-sector activities, boxes outlined in red represent assets and inputs into these activities; green shaded boxes and outlines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

59. 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).

60. 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.

61. 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.

62. 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.

63. 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.

64. 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.

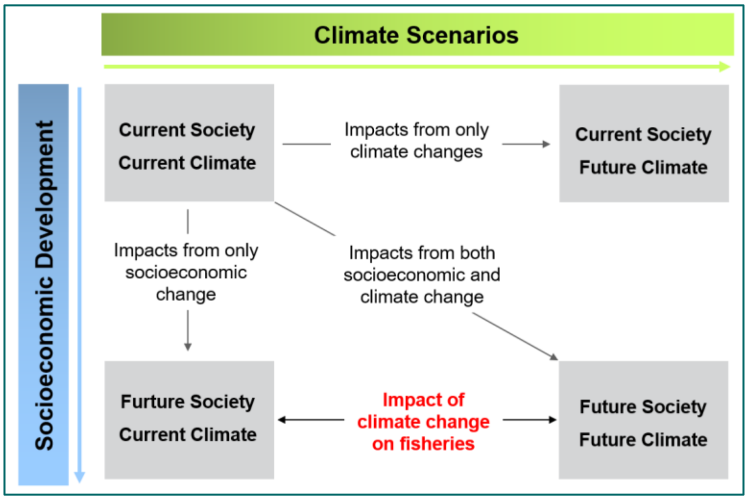

Figure 9: Separating impacts of climate change and socio-economic development

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

65. 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**.

<table>
<tr><th colspan="2">Indicator types</th></tr>
<tr><td><u>Physical</u>
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)</td><td><u>Ecological</u>
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</td></tr>
<tr><td><u>Catch and effort</u>
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</td><td><u>Socio-economic</u>
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</td></tr>
<tr><td><u>Risks and hazards</u>
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</td><td><u>Management effectiveness of fisheries sector</u> (Saint Lucia)</td></tr>
</table>

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

Monitoring system purpose

66. 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."* [17]

67. 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

68. 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.[18]

69. 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[19] 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.

70. 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.[20] 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.

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[17] 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:::::

[18] 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.

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

[20] 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.

71. 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 Saragassum 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.

72. 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.

73. 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.

74. 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

75. 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.

76. 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.

77. 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

78. 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.

79. 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.

80. 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

81. 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.

82. 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.

83. 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).

84. 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.

85. 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

86. 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

87. 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.

88. 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

89. 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

90. 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 Issac, 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.[21]

91. 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;
    - 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

92. 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.

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

Annex 1: 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
5	Haiti	Mr. Roger Charles	Fisheries Department Ministry of Agriculture Route Nationale #1 Damien Email: Roger.charles84@yahoo.fr
6		Mr. Blanc Moramade	Email: blamo82@yahoo.fr
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

	COUNTRY	PARTICIPANTS' NAMES & DESIGNATION	ADDRESS
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 Email: Allena.joseph@govt.lc
10		Mr. Thaddeus Augustin President	Castries Fishermen Co-operative Society Ltd. Castries Tel.: (758) 285-1413 Email: taugustin99@yahoo.com
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

	COUNTRY	PARTICIPANTS' NAMES & DESIGNATION	ADDRESS
19		Ms. Ava-Gail Gardiner Communications and Media Expert	Creative Director, Change Communications Ltd. Kingston, Jamaica (876) 873-6101 agardiner@consultant.com

Annex 2: 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

Annex 3: 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)	
September 17,	Presentation on simple tools to monitor	Pertains to Work Package 3: Engagement

Date	Milestone	Notes
2019	knowledge-attitudes-practice on climate-smart fisheries (Virtual meeting)	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)	

Annex 4: 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.

PRESS CONTACT:
CRFM
NAME: Milton Haughton, Executive Director
PHONE: 501-223-4443
E-mail: milton.haughton@crfm.int
Website: http://www.crfm.int/
CRFM social media links:
You Tube: http://www.youtube.com/user/TheCRFM
Facebook: http://www.facebook.com/CarFisheries and
Twitter: https://twitter.com/CaribFisheries

Annex 5: 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	Meteorolgical
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 licenced 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 sish 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 collecct dta - 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 firstand monitored for the most high valuespecies 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	Ther 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 nee 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 guiddelines

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 avaialble 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 heasily 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 skll 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 person 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 non 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	Comined data from NGO
Haiti	CNIGS
Haiti	CIAT - Interministry 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 relvant/user friendly information
St. Vincent & The Grenadines	Lack of appropraite 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 contraints, if the system is implemented the data can easily be shared to other countries.
Jamaica	Data sharing policy not devevloped 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 a 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. Rogger 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.