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DOMINICA CONSULTATION REPORT:

Fisheries Early Warning and Emergency Response

CRFM Secretariat
2018

Dominica Consultation Report: Fisheries Early Warning and Emergency Response

Prepared by:
ICT4Fisheries Consortium
Consultants,

under contract through the Marine sub-component of the Investment Plan for the Caribbean Regional Track of the Pilot Program for Climate Resilience, co-implemented by the Caribbean Regional Fisheries Mechanism (CRFM).

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CRFM Secretariat
Belize, 2018

The Fisheries Early Warning and Emergency Response (FEWER) System has been developed with support from the Regional Track of the Pilot Programme for Climate Resilience (PPCR) in the Caribbean which is executed by The University of the West Indies, Mona, through its Mona Office for Research and Innovation (MORI); and co-implemented by the Caribbean Regional Fisheries Mechanism (CRFM) with resources provided by the Climate Investment Funds (CIF) through the Inter-American Development Bank (IDB).

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DOMINICA CONSULTATION REPORT: FISHERIES EARLY WARNING AND EMERGENCY RESPONSE

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ACRONYMS AND ABBREVIATIONS

ADMIN	Administrator
AIS	Association of Information Systems
APP	Application (related to application program interface)
BFTC	Basic Fisherman's Training Course
CAP	Common Alerting Protocol
CARICOM	Caribbean Community
CARIFICO	Caribbean Fisheries Co-management (Project)
CC4FISH	Climate Change Adaptation in the Eastern Caribbean Fisheries Sector (Project)
CCA	Climate change adaptation
CCCCC	Caribbean Community Climate Change Centre
CCCFP	Caribbean Community Common Fisheries Policy
CDEMA	Caribbean Disaster Emergency Management Agency
CDRT	Community Disaster Response Team
CIF	Climate Investment Funds
CIMH	Caribbean Institute for Meteorology and Hydrology
CLME	Caribbean Large Marine Ecosystem
CNFO	Caribbean Network of Fisherfolk Organisations
CPACC	Caribbean Planning for Adaptation to Climate Change
CRFM	Caribbean Regional Fisheries Mechanism
DANA	Damage and Needs Assessment
DRCS	Dominica Red Cross Society
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DVRP	Disaster Vulnerability Reduction Project
EAF	Ecosystem Approach to Fisheries
ECHO	European Commission Humanitarian Aid
ECTEL	Eastern Caribbean Telecommunications Authority
EPIRB	Emergency position-indicating radio beacon
ER	Emergency Response
EW	Early Warning
EWS	Early Warning System
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization of the United Nations
FEWER	Fisheries Early Warning and Emergency Response
FMP	Fisheries Management Plans
GIS	Geographic Information System
GPS	Global Positioning System
HYDRO-MET	Hydro- meteorological
ICT	Information and Communications Technology
IDB	Inter-American Development Bank
ISDR	International Strategy for Disaster Reduction
ITU-T	International Telecommunication Union, Telecommunication Standardization Sector
JICA	Japan International Cooperation Agency
LAMA	Local Area Management Authority
MAGDALESA	Moored fish AGgregating DEvice in the LESser Antilles

MET	Meteorological
MHEWS	Multi-Hazard Early Warning Systems
MRCC	Maritime Rescue Coordination Centre
MORI	Mona Office for Research and Innovation
MOU	Memorandum of Understanding
NGO	Non-Governmental Organization
NHC	National Hurricane Centre
NIC	National Inter-sectoral Coordination Mechanisms
NTRC	National Telecommunications Regulatory Commission
ODM	Office of Disaster Management
PGIS	Participatory Geographic Information Systems
PPCR	Pilot Program for Climate Resilience
RDS	Radio Data Service
SAR	Search and Rescue
SIM	Subscriber Identification Module
SOCMON	Socio-economic Monitoring for Coastal Management (Global Programme)
SPCR	Strategic Programme for Climate Resilience
SRS	Software Requirements Specification
SSMR	Soufriere-Scotts Head Marine Reserve
TELCOS	Telecommunication service providers
UNDP	United Nations Development Programme
VCA	Vulnerability and Capacity Assessments
VHF	Very High Frequency (marine radio)

1 INTRODUCTION

1.1 Background

Fisheries Early Warning and Emergency Response (FEWER) is being implemented under the Caribbean Regional Track of the Pilot Programme for Climate Resilience (PPCR) over the period February 2017 to May 2018. The PPCR is being executed by The University of the West Indies through its Mona Office for Research and Innovation (MORI), with the marine subcomponent in partnership with the Caribbean Regional Fisheries Mechanism (CRFM).

As a programme of the Climate Investment Funds, the PPCR helps developing countries integrate climate resilience into development planning and investment. It comprises 28 national programmes and two regional tracks (the Caribbean and the Pacific) across the developing world. The CIF, through the Inter-American Development Bank (IDB), has provided grant funding to implement the Caribbean Regional Track. Under the marine sector subcomponent, the CRFM is working to reduce the impact of climate change related risks on the fisheries industry in the Caribbean.

This document sets out the findings from a country consultation visit to Dominica from 4-6 April 2017 to inform the FEWER solution. The findings are based on semi-structured and unstructured interviews with individuals and groups, a national consultation workshop and visits to fish landing sites. This report does not incorporate literature reviewed, or delve into options, or set out agreements among agencies. These aspects will be addressed in the country-specific FEWER proposal to follow.

1.2 Document Arrangement

This report follows the outline of the often-used checklist on developing early warning systems from the United Nations International Strategy for Disaster Reduction (ISDR). In particular, the findings of the stakeholder consultations are presented in sections drawn from the ISDR's four elements of people-centred early warning systems: (i) Risk Knowledge (ii) Monitoring and Warning Service (iii) Dissemination and Communication and (iv) Response Capability. Similar to the post-tsunami analysis in Asia, and current frameworks used in the Caribbean Large Marine Ecosystem (CLME), we take governance as underlying and underpinning all elements (Figure 1). The scope of interest, and corresponding content of the report, is the set of parameters that would guide the development of a fisher-focused, ICT solution for early warning and emergency response conceptualized to accommodate multiple actors, relationships and technologies (Figure 2). The report details the approach taken in the preparation and execution of the stakeholder consultations; and closes with a section on collaboration and conclusions. Appendices of contacts and other information are provided.

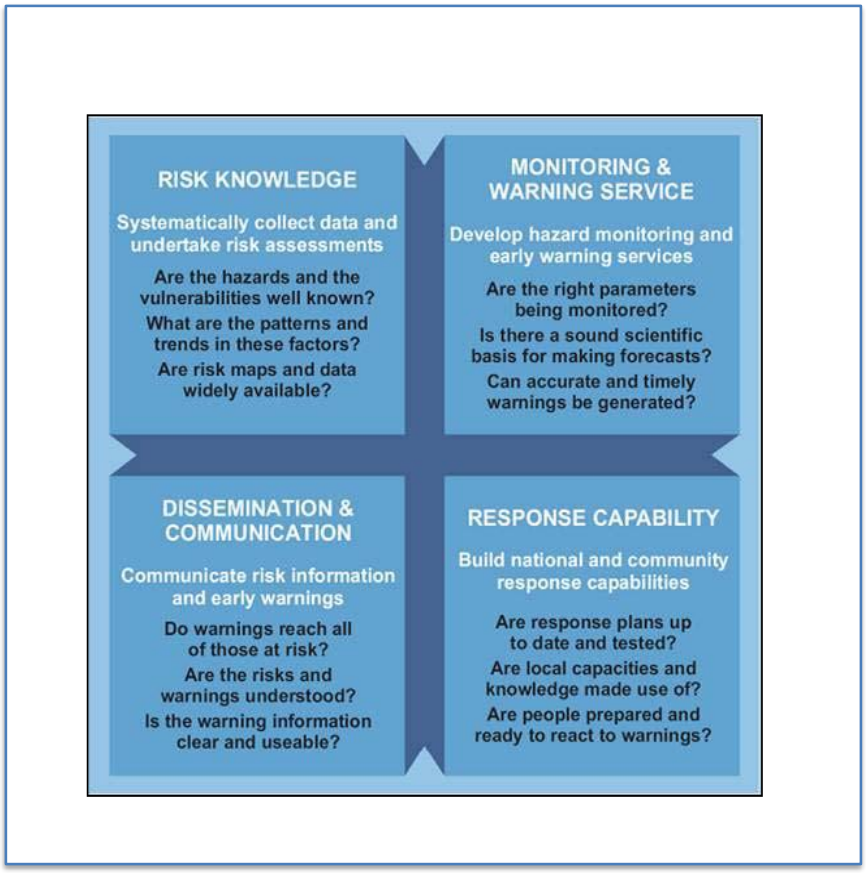


Figure 1. EWS are underpinned by governance

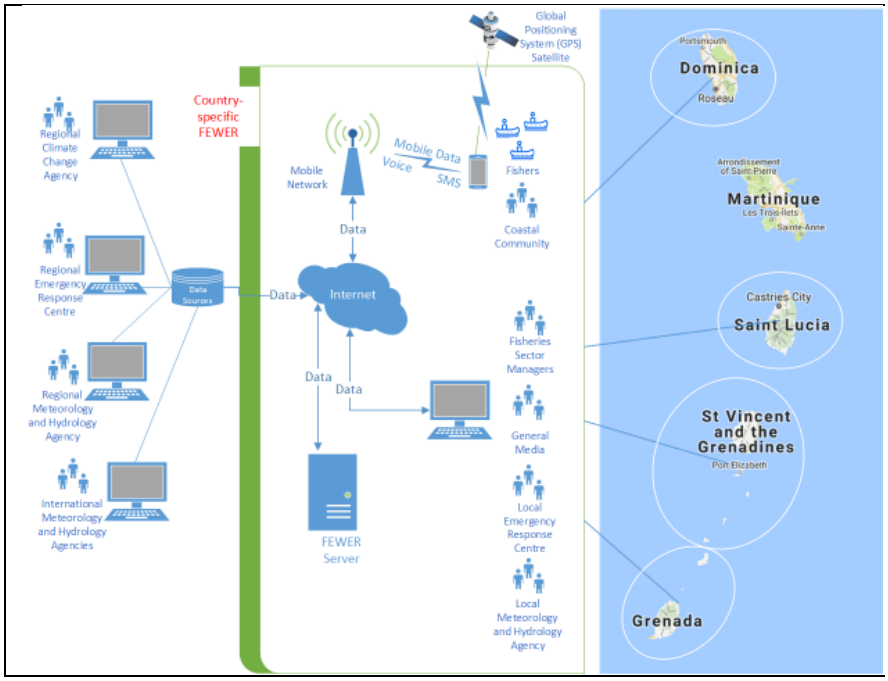


Figure 2. FEWER schematic for country specific solutions

1.3 Intended Audience and Reading Suggestions

As a major input into the country-specific FEWER proposal this report is intended mainly for interested parties and stakeholders in Dominica, and those regionally associated with the FEWER project, to be aware of and validate the findings. These actors and agencies include the fisheries authority, fisherfolk organisations, individual small-scale fishers and boat owners, meteorological services, disaster management agency, physical planning unit, coast guard/marine police unit, telecommunications regulator, CRFM, Red Cross and others. These actors have different perspectives and interests, and are unlikely to see the national situation in the same way. Yet, we need sufficient consensus on the validity of the findings to serve as the foundation for the solution, and confirm buy-in for its implementation.

Readers not immersed in the subject matter may wish to familiarize themselves with the most recent national report on disaster risk reduction (DRR), the PPCR project and the report of the 2016 CDEMA-led Caribbean Early Warning System Workshop.

Note that emergency response is typically taken as a final component of EWS. In this work that focuses on the Dissemination and Communication component we treat early warning and emergency response as separate, but closely related, since there are both critical similarities and critical differences regarding communication characteristics and requirements. Readers may use this report as a resource, or baseline, for maintenance and further development of FEWER beyond the lifetime of the original project. The intended audience therefore also includes future teams who may wish to modify or extend the software solution or other aspects of information and communication technology (ICT), as well as those who wish to address associated fisheries-related challenges and opportunities.

2 APPROACH

2.1 Logistics

Following an inception meeting with the CRFM Secretariat, the FEWER project was formally announced (Appendix 1) and liaison contacts assigned by the fisheries authority and the Caribbean Network of Fisherfolk Organisations (CNFO) (Table 1). The dates for the country visit were agreed with the fisheries authority and the visit followed the programme in Table 2. The national workshop (in Roseau) and two planned site visits (in Scotts Head and Soufriere) were well publicised (Appendix 2) with the assistance of the liaisons. Site visit locations were selected using criteria in consultation with the fisheries authority. The consultants prepared to use and adapt to the checklist (Appendix 3) for context-specific analysis.

Table 1. National consultation liaisons

Liaison	Affiliation
Norman Norris	Fisheries authority
Zethra Baron (Ms)	Fisheries authority
Kirby Birmingham	CARIFICO Liaison

Table 2. Pattern of activity for three days

Time	Arrive day	Main day	Leave day
Morning	Arrive	Meeting of national EW and ER key interests	Gap filling meetings and info gathering
Afternoon or evening	Final plan with local organiser	Community site scoping and meeting	Leave

The FEWER team comprised fisheries specialist Patrick McConney and ICT specialist Kyle DeFreitas. Key informant interviews on the first day guided information exchange in the national consultation workshop held at the Fisheries Division in Roseau on the morning of the second day. Norman Norris was host of the workshop. The afternoon visit was to adjacent fish landing sites Soufriere and Scotts Head (Figure 3). The Fisheries Division provided transportation. Appendix 4 lists people contacted in the country consultation interviews and workshop. A slide presentation was used only for the workshop which had the four stages shown in Figure 4.

Figure 3. The fish landing sites visited in Dominica were Soufriere and nearby Scotts Head

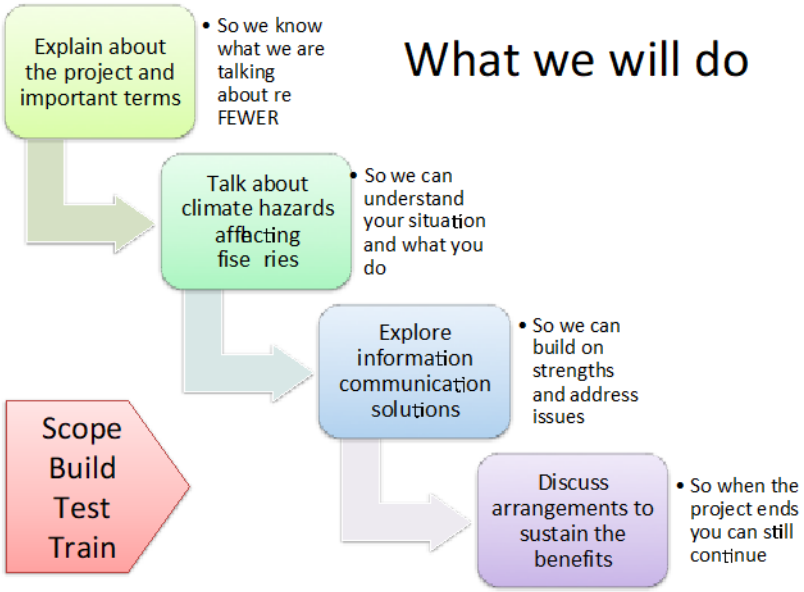


Figure 4. Organisation of the national workshop

2.2 Organisation

Findings from different sources and explanatory graphics from slides are functionally grouped under the checklist headings, rather than be set out by interview sources or day, so as to minimise redundancies. Interviews followed standard research ethics procedures in which the purpose and research affiliations were explained and respondents offered the choice of participating or not. While strict anonymity and confidentiality were not promised given the small pool of informants, respondents understood that they were not going to be quoted or unnecessarily identified in the reporting. Unless indicated otherwise, the reader can take the reported findings as the collective view of all contacts. We avoided questionnaires and ICT (e.g. smart phone app) demonstrations as these may have restricted or biased responses. In particular, we sought to avoid biases towards a solution that could be supplied prior to understanding the nature of the demand side of the solution, or reasons for lack of demand, freely articulated by the respondents. Interview notes and photos were shared with the remainder of the ICT4Fisheries Consortium for review and analysis. The views of the CNFO were particularly sought for understanding fisherfolk perspectives.

2.3 Scope

Contacts were reminded that the FEWER solution was intended to address the interface in disaster risk management between EW and ER immediately before and after a potential impact (Figure 5). They appreciated that a fisheries sector climate hazard solution needed to fit, and be closely linked to, the cross-sectoral, multi-hazard and multi-level architecture of national and regional systems (Figure 6). Any solution would thus be constrained and enabled by the surrounding system in which it was embedded.

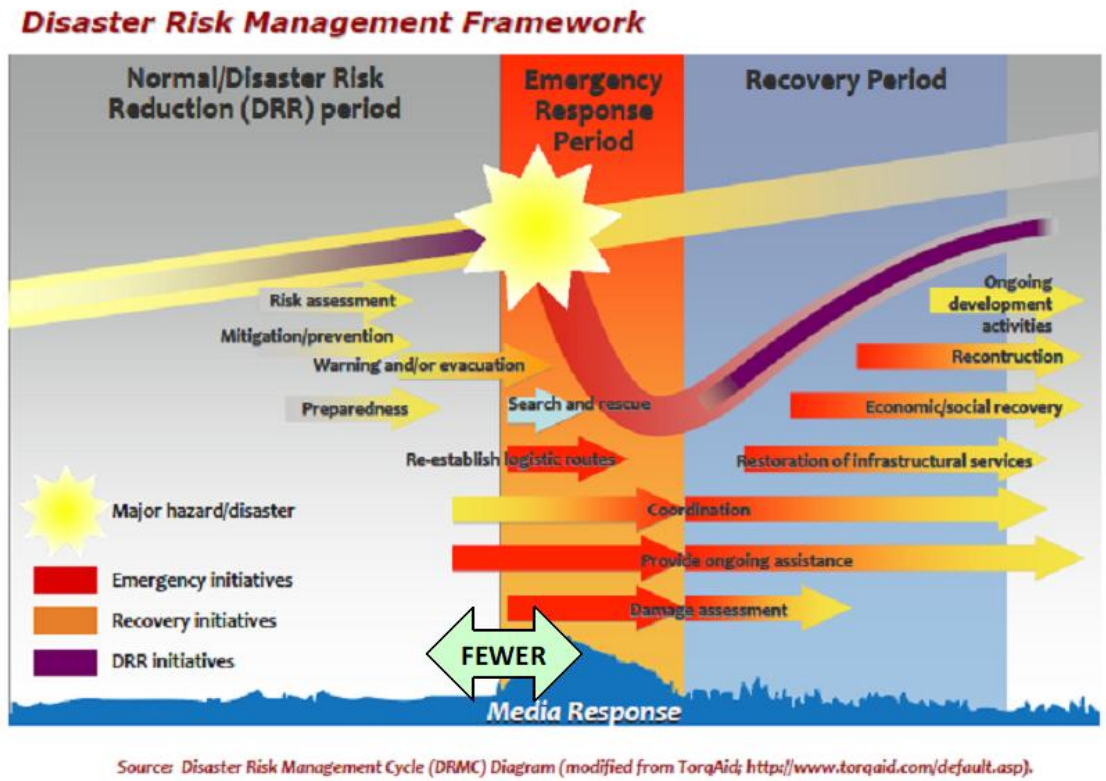


Figure 5. FEWER at the interface between EW and ER

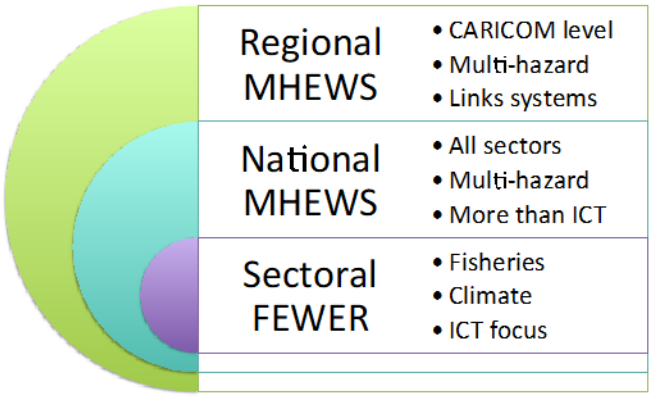


Figure 6. FEWER as a part of a larger multi-hazard and cross-sectoral, nationally to regionally networked EWS

Regarding the climate scope and focus on hydro-meteorological (hydro-met) hazards, contacts were reminded that the aim was primarily to address rapid onset climate variability and extreme weather event risks while also preparing for slower onset changes (Figure 7). While the project scope did not specifically include geological, technological and biological hazards (Figure 8) a FEWER solution would need to be able to accommodate expansion to these in keeping with multi-hazard early warning system (MHEWS) best practices. Conveniently, there are on-going initiatives to tackle some of these such as tsunami early warning[1], sargassum early advisory[2] and oil spill contingency plans[3].

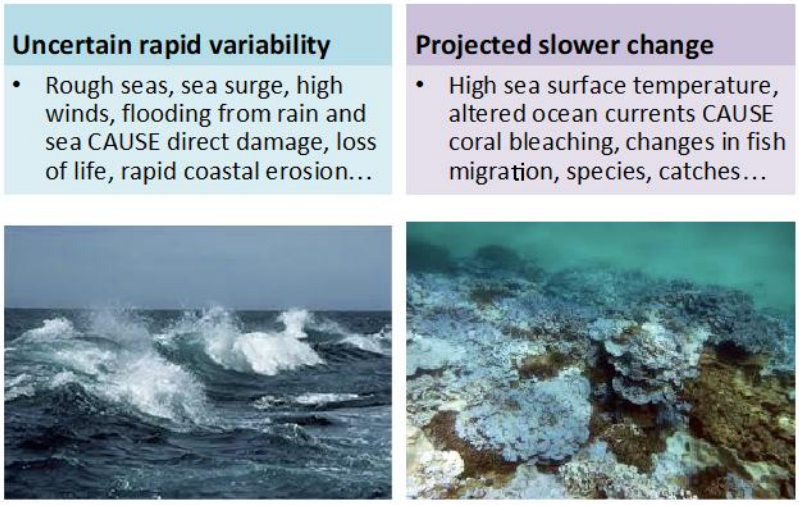


Figure 7. FEWER focuses mainly on rapid onset climate hazards but slow onset changes cannot be ignored in longer term fisheries plans

[1] Caribbean Tsunami Information Centre (CTIC) http://www.bb.undp.org/content/barbados/en/home/operations/projects/crisis_prevention_and_recovery/caribbean-tsunami-information-centre.html

[2] Sargassum Early Advisory System http://seas-forecast.com

[3] Caribbean Islands OPRC Contingency Plan http://cep.unep.org/racrempeitc/regional-oprc-plans/caribbean-island-oprc-plan

Figure 8. Some hazards of fisheries interest are not hydro-meteorological, but FEWER can expand to include

Scope also covered the type of information being sought and the form in which it was communicated. In order to emphasise our need in this pre-design phase to understand, not just describe or quantify, the demand side characteristics for a FEWER solution we focused on soliciting "stories" (Figure 9). That is, we sought the reasoning behind actual actions, perceptions and aspirations through probing narratives. Disaster practices are often best understood in the context of livelihoods (Figure 10). Thus, we also sought to get an array of qualitative information ranging from normal everyday practice to actual hazard event experiences, and to what the diverse contacts thought was desirable for the future.

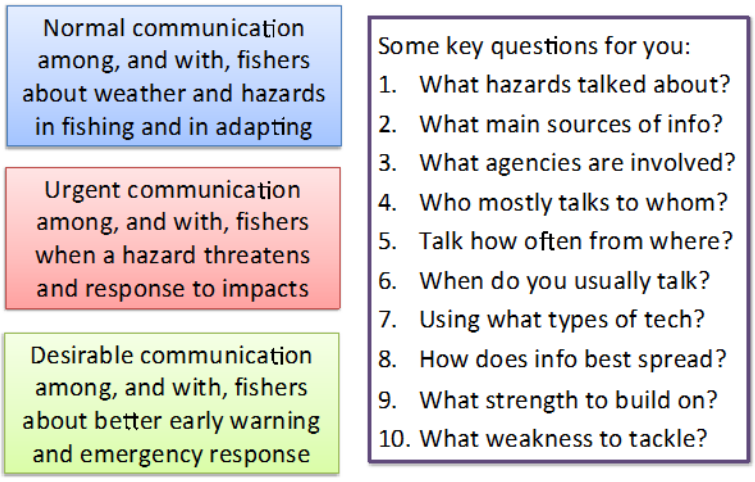


Figure 9 Seeking information on communication practices in real-life experiences through stories

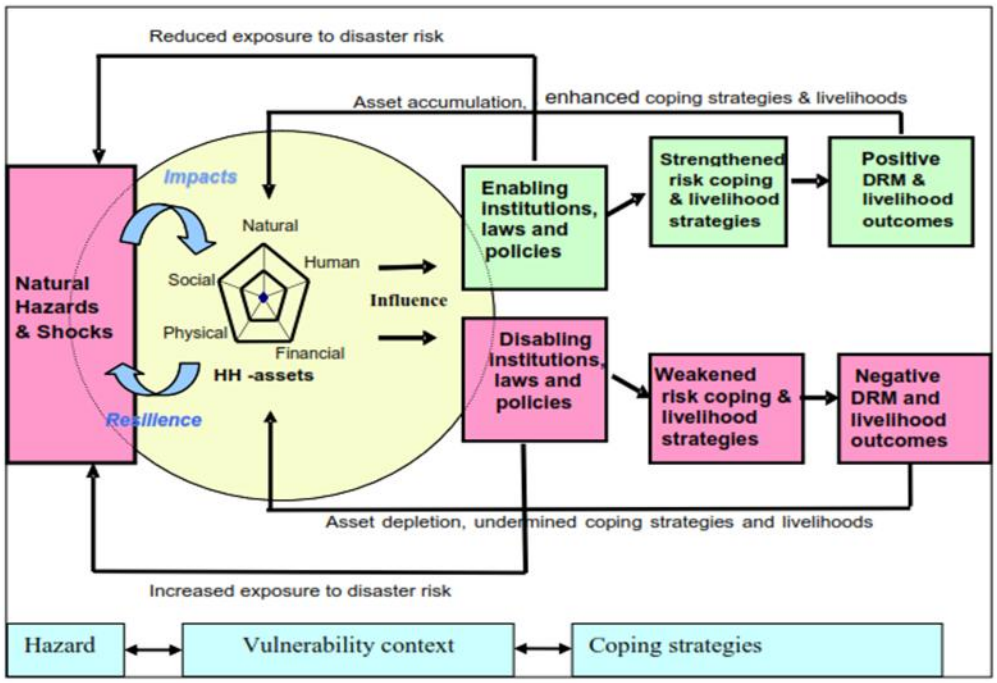


Figure 10. Disaster practices are taken in the context of livelihood assets, institutions and strategies (Source: Baas and others 2008)

Normal conditions reveal what is customary and practical and likely to be used. Behaviour in actual hazard experiences reveals what additional features are important. Ideas on future requirements help to identify emerging needs as well as innovators and early adopters of new technologies and processes. For each of these, similar questions help to characterise practices. The information from interviews, the workshop and observation was assembled from diverse contacts to address the checklist. The following four sections set out the findings most relevant to the FEWER solution, including enabling and constraining factors that go beyond the immediate project scope, but influence viable options.

3 RISK KNOWLEDGE

Risk knowledge is about understanding the nature, pattern and trends of fisheries sector vulnerability based upon which hazards pose serious threat where, when, how and to whom. Contacts were reminded of what EW and ER mean in practical terms (Figure 11) and how EW and ER differ in risk knowledge characteristics (Figure 12).

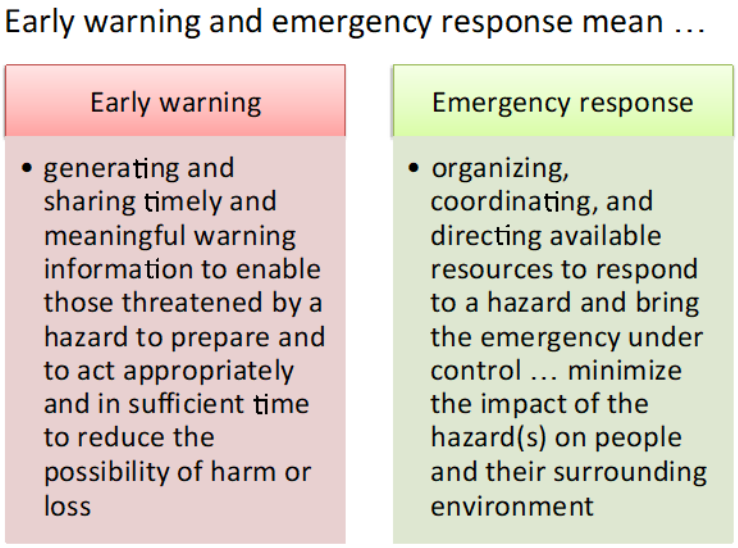


Figure 11. Early warning and emergency response explained

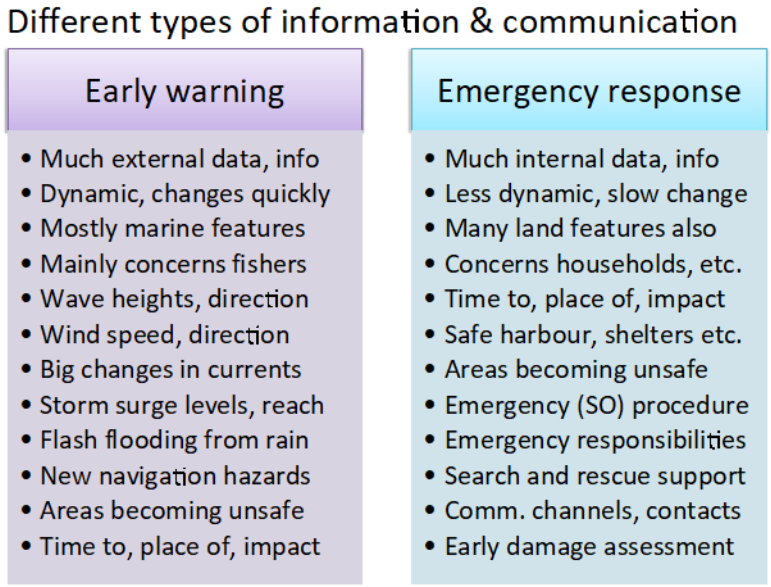


Figure 12. EW and ER differ in information characteristics

Regarding organisational arrangements, contacts (Appendix 4) confirmed that their organisations would be among the main national knowledge contributors and consumers in a FEWER solution, while others would play supporting roles. They said that:

- Office of Disaster Management (ODM) and Fisheries Division would have the most responsibility in both EW and ER, but especially the former.
- Meteorological Services and Red Cross were deemed crucial for EW and ER respectively.
- The law provides ODM with a clear mandate and jurisdiction over disaster-related matters and is adequate for the FEWER, and multi-stakeholder engagement was based on ODM's authority

- MOUs with agencies included in the national MHEWS are not customary, but a simple FEWER MOU would not be unacceptable.
- National climate and disaster data and information standards are inadequate for the fisheries sector which has focused more on conventional matters such as catch and effort and not yet EAF, CCA and DRM. The recently started FAO project on Climate Change Adaptation in the Eastern Caribbean Fisheries Sector (CC4FISH) offers an opportunity to address deficiencies.
- There is limited national scientific and technical expertise for dealing with fisheries–related risk data but FAO, UNDP and PPCR initiatives may address this.
- Frequent staff changes and poor institutional memory (documentation) plague the public sector
- Regularly collected and updated risk data are limited, risk data being mainly found in ad hoc external project reports which vary in methods and coverage. When CCA and DRM are incorporated into fisheries management plans (FMP) under CC4FISH this should improve.
- Strategies to actively engage fishing communities in risk analyses vary, but ODM and the Red Cross are actively involved. Under CC4FISH there is provision for conducting fisheries-specific vulnerability and capacity assessments (VCA) that could greatly improve EW and ER data.

During the visit contacts confirmed the climate natural hazards previously identified. In the national consultation workshop they were encouraged to add details on which aspects were of greater or lesser priority for an ICT solution regarding both EW (Figure 13) and ER (Figure 14). They were asked to do so without constraint on feasibility, as operationalization would be addressed in the FEWER proposals once demand was clear. No fishers attended the workshop due to communication and logistic issues. The agencies did not want to prioritise EW on their behalf. However, they felt confident that they could prioritise ER requirements needed by fishers as these were generally applicable to most coastal users.

Hazard features as a fisheries ICT priority

Features to consider in EW	Low priority ——————————-High priority				
Rating —->	1	2	3	4	5
Rough seas generally, wherever					
- Sea swells, in open ocean					
- Wind waves, in open ocean					
- High surf, mainly near to shore					
High wind, maybe >20 knots					
Wind direction and speed					
Currents, speed and direction					
Storm surge, how high and far					
Rain flood, flash flooding likely					
Water temp., coral bleaching?					
Visibility, hazy atmosphere					
What else?					

Figure 13. Hazard features as a fisheries ICT priority was not filled in due to the absence of fishers at the consultation

Emergency response as a fisheries ICT priority

Features to consider in ER	Low priority ————————-High priority				
Rating —->	1	2	3	4	5
Time to, place of, impact					x
Sea areas becoming unsafe				x	
Land areas becoming unsafe				x	
Safe harbour, hurr. shelters etc.			x		
Plans for boats, marinas, etc.				x	
Comm. channels, contacts				x	
Emergency (SO) procedures				x	
Emergency responsibilities			x		
Search and rescue support				x	
Community disaster team info				x	
Early damage assessment info				x	
Other? What?					

Figure 14. Emergency response as a fisheries ICT priority was filled in since agencies were confident about the priorities

The consultations had no need to go into the vulnerability details of exposure, sensitivity and adaptive capacity but all contacts agreed that cyclonic and other weather events of greatest concern were:

- Tropical depressions to category 5 hurricanes, during the Atlantic hurricane season
- Northerly swells generated by northern storms in the first quarter of the year
- Sudden and surprising squalls, wind gusts and high surf from ocean to shore
- Low visibility from haze (cloud and Sahara dust) that confused visual references
- Flash flooding from rainfall, mainly but not always in the hurricane season
- Coastal inundation particularly from combinations of storm surge and rainfall

Fishers and fisheries officers voiced views on fisher attitudes towards risk such as:

- Fishers normally accept high levels of risk, and actively seek risks that challenge their abilities
- Some fishers want to brag about going to sea when others turned back or did not leave shore
- Despite receiving early warning, some fishers will still venture to sea unless the threat is critical
- Risk-taking fishers may be rewarded by making landings at good price with little competition
- Fishers often say that when the sea is roughest is when the fish are plentiful (for the brave)

Other points made concerning risks, natural hazards and community vulnerability analysis included that, concerning data and information stored and accessible on FADs:

- Historical data on hazards exist in accessible literature and data sets, but data quantity and quality vary. For example, there is much on precipitation and flash floods but less on sea state
- Fish aggregating devices (FADs) assist safety at sea as well as improve incomes
- Estimate 70% of fish now from offshore (20-40 miles) FADs, so know where fishers go
- FAD map can be made available via CARIFICO project but not generally available
- FAD locations could be made ‘dynamic’ by switching on and off time-stamped layers
- CARIFICO rep agreed to this, but apparently no incentive to have this done
- Locations of public FADs and frequent disappearance of FADs require regular updates

Regarding hazards and risks they noted:

- Disaster management tends to be reactionary and low priority for government
- Regarding hydro-met hazards, there is more emphasis on rivers flash flooding than marine area

- There is not usually enough advance warning of marine hazards, except for major storms, based on using model projections alone that do not take small-scale local conditions into account
- Flash flooding damages boats when watershed debris from by rivers enters the inshore region that is experiencing rough seas or storm surge. This type of multi-hazard interaction is of particular concern to the Caribbean Disaster Emergency Management Agency (CDEMA).
- Existing hazard maps do not cover all climate hazards or coastal fishing communities, and hazard interactions are not well researched, but this is improving (note CC4FISH previously mentioned)
- Authorities and NGOs are already sensitive to factors such as gender, poverty, disability, access to infrastructure, economic diversity and environmental impacts, so will consider these
- Contacts knew that general information on hazards was available from international, regional and national sources. Fishing industry stakeholders said, however, that the available information was not always useful due to difficulties with access to sources, predominance of technical language, how uncertainty was expressed, and other communication deficiencies.
- Almost all fishers listen to the morning weather forecast and heed marine advisories well
- There seems to be a largely untapped opportunity to incorporate more local knowledge into risk mapping and analysis and make it available to a variety of stakeholder online. This can be via participatory geographic information systems (PGIS) coupled with visualisation.

The latter topic was expanded upon regarding geographic information systems generally, noting that:

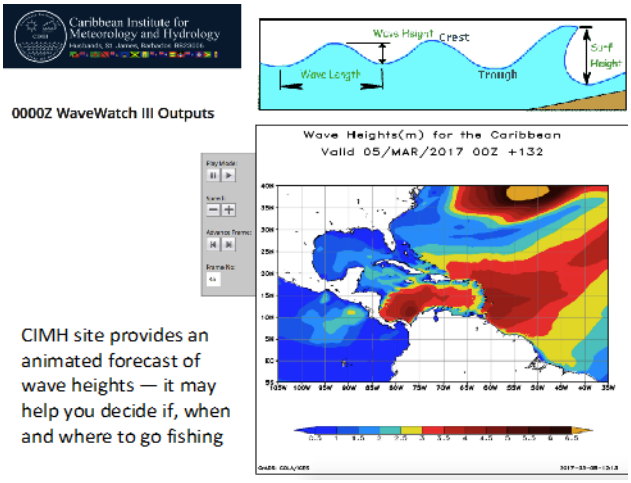
- Capacity for PGIS was said to be low in the key agencies but has increased such as through the use of SocMon Spatial and other tools often associated with marine spatial planning.
- GeoNode was used at ODM, but expertise now mainly with Physical Planning; Fisheries Division currently has GeoNode expertise on staff but not used for PGIS routinely
- Physical Planning was the lead for such information in other climate projects including under the PPCR and with the Caribbean Community Climate Change Centre (CCCCC)
- DomiNode (national GeoNode portal) available online to public is underutilised but trying for revival of interest; not used for local knowledge but has potential
- DomiNode site accessible by public; currently of renewed interest; http://dominode.dm
- DomiNode was previously open, but inaccurate data layers were allegedly submitted
- Now closing layer upload access and using verification process to communicate QA/QC
- Uncertain what the data and layer provision protocols and permissions will be, or when
- DomiNode may be good, potentially, for local knowledge layers and FAD locations
- ICT Unit had no knowledge of DEWETRA; so far ODM is not contributing layers
- DomiNode currently contains hazard map layers and several marine layers
- Could be a challenge for government committee to decide swiftly enough for data use
- National standards and protocols for data storage and access, including open data standards, are receiving some attention, but much of this is project linked and not routine

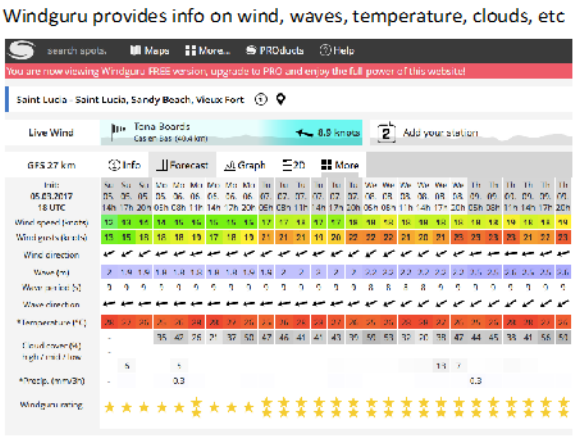
The full potential for incorporating risk assessment into fisheries sector plans, and hence a FEWER solution, is not yet realised for many of the above reasons. However, this is a good time to bring together several compatible initiatives to build more coherent policy, planning and management.

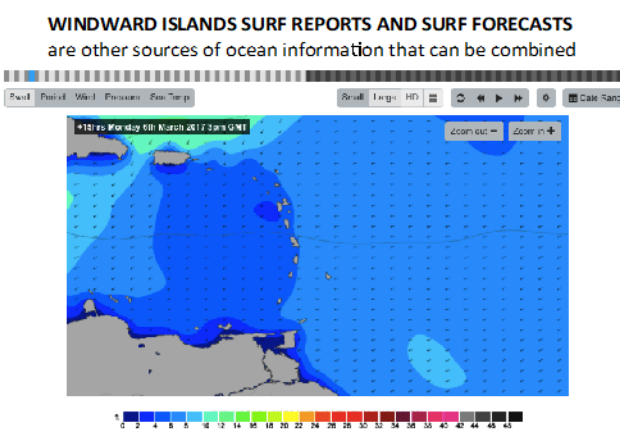
4 MONITORING AND WARNING SERVICE

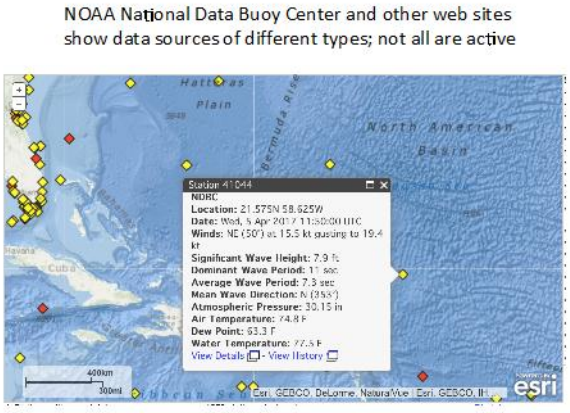
In this section we address mainly the data aspects of the EW and ER services as communication is dealt with subsequently. The demand side structure for any fisheries-related monitoring and warning service for climate risk reduction and management was discussed with contacts. The few hundred operational vessels in the fishing fleet are mostly small (<10m), wooden or fiberglass, open pirogues or similar design using

one or two outboard engines for propulsion. Their target species, fishing methods, fishing gear and range from shore vary. However, for a FEWER ICT solution contacts said fishing enterprises could be treated as one market facing similar risks at sea and ashore. A national monitoring and warning service was deemed to suffice and would probably be the only level feasible and affordable, but some community-based features would be important in keeping with disaster agencies' focus on community-level capacity. Interviews and the national consultation workshop explored several online sources, uses and users of hydro-met data and information (Figure 15).









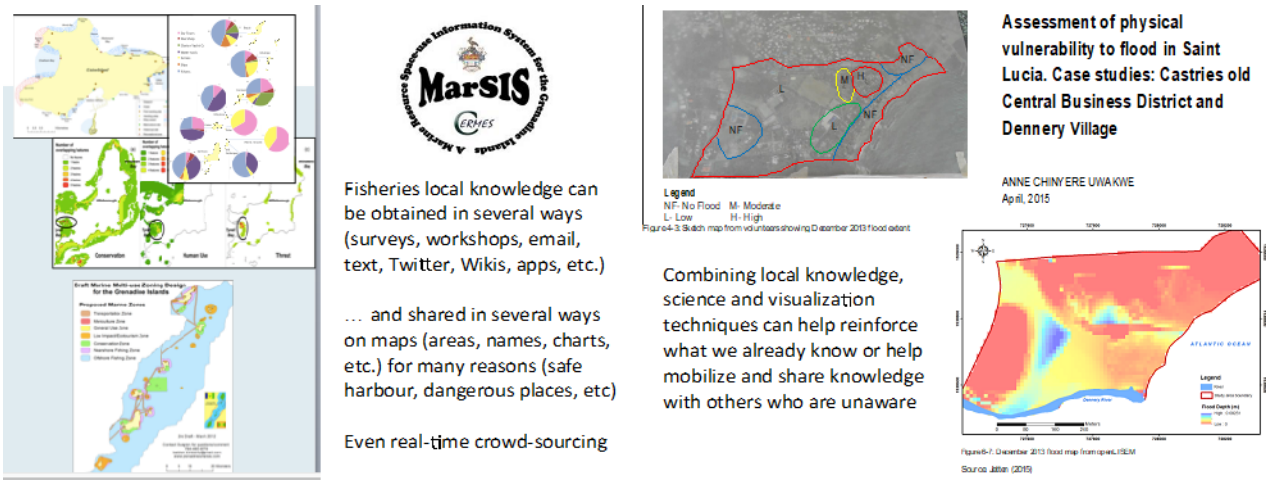


Figure 15. Sources and visualisations of hazard monitoring information form the basis of early warning and emergency response

Referring to the EWS checklist, and ignoring redundancy with points addressed previously under risk, a critical finding was that Dominica invested in implementing the Common Alerting Protocol (CAP) that allows emergency messages to be simultaneously disseminated over a wide variety of existing and emerging public alerting systems. CAP was introduced by a UNDP project that is currently ending. It has implications for data and information types, sources, formats and other requirements in the Software Requirement Specification (SRS) and other parts of FEWER. The ODM lost its in-house CAP capacity due to recent staff movements, but retains the server. FEWER proposals need to take CAP into account as well as be aware that the ODM is seeking alternative alerting services. The national fisherfolk body is well developed with active primary (fish landing site) organisations. Other points, many made in key informant interviews and the national consultation workshop, concerning institutional mechanisms, forecasting and warning were:

- ODM's institutional mechanisms for fisheries-relates monitoring and warning are fairly adequate, but a more targeted effort such as by FEWER would be welcomed for fishing industry
- Dominica Met Service has two forecasters and one person dealing with instruments
- Due to a longstanding agreement, the Barbados Met Service provides forecasts for Dominica
- Dominica Met Service "tweaks" the marine forecast from Barbados to reflect its observations
- Many online products presented in the workshop are used regularly by Met Service forecasters
- WindGuru and Magic Seaweed are two of the most useful online sites for informing forecasts
- DEWETRA is seldom used but Met Services appreciates its potential for use by combining model forecasting products and static GIS layers
- Forecast validation is mainly from Met buoys by Martinique; no aim yet to validate via fishers
- Disaster Vulnerability Reduction Project (DVRP) emanating from Dominica's Strategic Programme for Climate Resilience (SPCR) is to provide building for Met Services, water level sensors and tide height sensors
- Marine forecasters need more hydro-met buoys at sea for obtaining real-time validation data
- Uses Facebook to reach the public, but no regular feedback from fishers on forecasts
- Met Service forecasters get more personal than formal requests from fishers for hydro-met info
- Met Service does not use creole language for forecasts except on 'Creole Day'; no need for this
- Regular sector-specific and highly localised impact-based forecasting may be impractical due to data requirements and capacity of the Met Services even if benefits were said to exceed costs
- Only marine sensor in use is for sea level at Coast Guard base as part of tsunami early warning

- Public sector agencies and fishing cooperatives with regular working hours would not have the human resources to offer 24/7 support for FEWER unless a threat was imminent
- Marine forecasts valid for 24 hours emailed to agencies and the public at 0600, 1200, 1800 daily
- The sudden rough seas that fishers experience cannot be now-cast and communicated to them
- Some fishers do not understand marine forecasts due to met jargon and metric measurements
- No agreed way to get local knowledge of marine weather or to crowd source (not using Twitter as promoted by CIMH as few people tweet)
- Most search and rescue (SAR) is due to engine failure and running out of fuel, not bad weather
- Poor visibility can be a problem for fishers as positioning is often by landmarks described in fishermen terms that Coast Guard does not understand
- Local knowledge and practices that provide simple useful weather information to be considered
- Met Service queries the relationship between risk-taking at sea and the weather forecast or alerts as fishers use other data and experience for decision-making on risk taking at sea
- Often the time lag between forecast conditions and them being observed leads people to think that the forecast is wrong simply because they do not consider the forecast period or updates
- NHC forecasts do not adequately take into account Dominica's high relief topography
- Consequence is that flash flooding cannot be well forecast from online models alone
- Need to convert metric measurements in to Imperial for the public and use less jargon
- Only in major hazards Met Service also issues audio alerts in creole language too
- FM music/talk radio and religious radio stations all carry the weather forecast

Some points were made specifically on the Common Alerting Protocol (CAP) and warning systems:

- Need to retrieve the data from river sensors via a web site login; no automatic warning to CAP
- All of the CAP infrastructure was put in place, including at radio stations, but had server issues
- Not all agencies in the national disaster management system were sufficiently informed about CAP, which made examination of data types, sources, formats, etc. difficult for them now
- Various reports document issues being addressed in regional to national linkages in the MHEWS
- System-wide tests and exercises are organised, but this did not mean that the fisheries sector was adequately prepared, especially for events that were marine, not requiring national EW, ER

Familiarity with and use of ICT in warning was discussed:

- Practical benefits of ICT were demonstrated to fishers under the Magdalesa Smart FAD project
- Fishers were able to get FAD position, oceanographic conditions etc. on desktop or smartphone
- No FADs currently deployed have sensors or transmit GPS coordinates real time
- Planned with Met Services to have Smart FADs record meteorological data as well, but not done
- Government data collectors get info from FAD fishers and can show them trends, data value
- Fishers have 1-3 GPS units to carry and store data; few use GPS app on smart phone
- Need to link ICT use to livelihoods and household well-being, demonstrate value-added
- Each community has innovative fishers for ICT; most younger fishers use smartphones
- Unclear as to whether many fishers may use desktop computers at home or in co-ops

5 DISSEMINATION AND COMMUNICATION

The consultations examined the several ICT options available for EW and ER and the need to determine what ICT combinations were useful and feasible in a country-specific situation (Figure 16 and Figure 17). It was agreed that a multi-part solution would be necessary, but further input was needed to specify the parts, the actors, the relationships and the technologies amongst other variables. In order to get a broad

view of communication options, none were ruled out in discussions, but contacts expressed their preferences and gave reasons to support their views.

Figure 16. ICT options for features of early warning

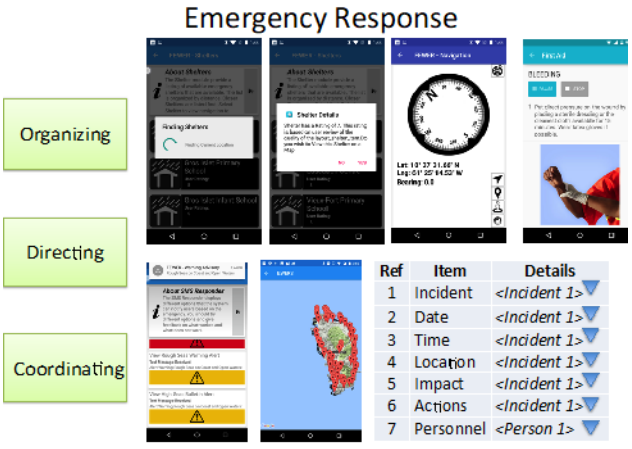


Figure 17. ICT options for features of emergency response

In overview, fishers mainly use cell phones for communication ashore and at sea when within range (up to about 15 miles from shore). Many fishers who have smart phones do not take them to sea for fear of loss or damage. Instead they take either regular, or ruggedized and waterproofed, phones to sea. Phones are secured at sea in containers with other valuable and vulnerable property, or worn on the fisher in waterproof transparent pouches. The latter are less common. The phones are treated mainly as emergency devices for making outgoing calls when in distress.

Summarising findings from the visit with reference to the organisational aspects in the EWS checklist:

- ODM has set out institutional powers, processes and protocols for communication in disasters
- Government has an IT department that could be relevant to integrating FEWER; e.g. Dominode
- Communication networks for reaching fishing enterprises, households and communities are not well defined, are diffuse, and comprise a mix of formal and informal components
- Volunteer EW and ER communication networks, (including ham radios) are associated with Community Disaster Response Teams (CDRTs) but not specific to any particular economic sector
- Red Cross CDRTs that communicate on terrestrial VHF; have access to VCA maps for reference
- In general, national and community disaster communication systems are well developed and are constantly upgraded mainly through externally funded projects such as what introduced the CAP
- There are current challenges with the CAP, mainly concerning technological problems with the project-supplied Radio Data Service (RDS) EW receivers; unaware of plans to deal with RDS units
- CAP was tested and is working except no TV interrupt; citizens can sign up to receive CAP alerts
- Suggestion by some that ODM should also relocate the CAP server to ICT Unit support
- ICT Unit provides support for CAP more remotely that some other government IT infrastructure
- No known sensors connected to CAP for automated alerts to ODM for decision-making; relies on Met Services instrument person as ODM has no instrument or IT capacity
- There is no one particularly outstanding radio personality who is important in forecast and EWS

Contacts provided additional details in the national consultation workshop and interviews on communication systems and equipment:

- Met Services would support development of an app or other means to communicate better
- Forecasts at 0600 and 1800 from Met Service also available via phone hotline recording that is well used; link to it is also on Facebook page
- Most fishers are said to heed marine hazard advisories and stay ashore or go to sea cautiously
- Fishers' phones often have little credit and data services are is not usually sought at sea
- WhatsApp and other social networking media are used, but not expressively for fisheries circles
- Fishers listen to the media broadcast marine forecasts even if not going to sea. Through social networks these fishers are sources of info for other fishers, and this is not dependent on kinship
- Literacy in English does not constrain fishers understanding audio broadcasts and text messages
- ODM would be cautious about encouraging layman value-added impact forecasts as they may be misunderstood or be misinforming regardless of disclaimers by citizen communicators
- Coast Guard accepts and expects cell phone calls from fishers in emergency; typical problems with inability to provide position and fisher impatience with questioning to identify vessel, etc.

Points made on communication within and by the fishing industry included:

- Fisheries community communication is mainly by word of mouth within social networks; women included and functions 24/7
- Fishing partners tend to call each other when going to a fishing location that is out of cell range
- ODM recently started a project with Ericsson to upgrade disaster communication
- Fishers use phones to talk about FAD fishing success; check-out when leaving FAD
- FAD fishers especially call each other when any fisher is late; which FAD last seen at
- Creole versus English language is allegedly not a problem; fishers conversant in English
- Basic Fishermen's Training Course (BFTC) (Figure 18) has run for 12 years with 40th one next; BFTC includes radio training by coast guard; NTRC invited to speak at next course; can include more ICT in BFTC
- Average age of fishers is declining, and there has been increased demand for BFTC, so this should be good for ICT
- Fishers use several phones (or dual SIM) and service providers including providers in Martinique
- Experience of cell service being overloaded during events; no use for emergency calls
- Have had flash flood events not forecasted being observed, and then people call ODM to share
- ODM can send free SMS via informal agreement with Flow and Digicel including threats and hazards not warranting a national alert

A few arguments were heard for increasing the use of marine VHF radio:

- Fishers who carry marine VHF to sea do so for emergency communication with the port or other vessels such as yachts and ships, not other fishing boats; Fisheries Division will emphasise use of marine VHF radio in FEWER solution
- While VHF marine band frequencies can be used for transmitting automated recorded EW and ER advisories, if the technologies of the sender and receiver are capable, use would be limited
- Low use of marine VHF radio was in part due to licence cost and NTRC administrative processes when compared to the simplicity of obtaining cell phones
- Coast Guard base is in a poor location for communication on marine VHF without a repeater
- Confirmed no marine VHF repeaters for public use and no current plans for them; but aware lack of repeaters causes several areas of poor signal
- Planned for Japan International Cooperation Agency (JICA) VHF repeaters to be installed, but politics allegedly prevented progress

- Marine Unit marine VHF range only 15-20 miles to the west from an antenna on base; but there are repeaters for police use marine and terrestrial bands giving wider coverage
- MRCC in Martinique uses high tech and satellites to monitor VHF Ch 16 in entire area around Dominica and passes distress calls to Dominica Marine Unit if necessary
- When in distress fishers use phones to call friends and relatives, only then, maybe police
- Most fisheries distress calls are engine failure not weather related
- When fishers do adrift to another country the Marine Unit is alerted
- No specific strategy to promote or discourage use of marine VHF, either as emergency aid or for general marine communication, but accept it is and will be little used by fishers
- Coast Guard is not against EPIRB use by fishers as would greatly assist SAR if coupled with AIS, but aware of large number of false alarms due to people "playing with" EPIRBS
- National Telecommunications Regulatory Commission (NTRC) complicated application form and high fees are obstacles to marine VHF use
- Coast Guard and Fish Division assist fishermen to get around NTRC constraints for VHF
- Fisheries Division getting NTRC to participate in next Basic Fishermen's Training Course
- Coast Guard concern that fishers too irresponsible to use VHF properly will be nuisance
- Coast Guard concerned VHF radio communication may assist more drugs, illegal activity
- Fisheries Division was developing manual for VHF to improve proficiency, reduce abuse
- No information on if there is a favourite VHF set in use or recommended for fishers
- Fishing cooperative or community level VHF base stations needed to facilitate self-help
- ODM advocates marine VHF for normal communication, but not ODM mandate to promote

Agencies likely to be involved in the FEWER solution use a variety of ICT, but much is still conventional (Figure 19) rather than using more recent internet and smart phone social media products and services.

Figure 18. Basic training course for fishers includes VHF communication

Actor use of types of com	Phone call	SMS text	Whats App	Mobile App	Desk -top	VHF radio	Ham radio	Email	Face-book	Twitter
Fish Dept	x	x	X staff			x		X co-ops	x	
Fisherfolk	x	x	x			x		x		
Fisher Org	x	x	x			x		x	x	
Met. Service	x	x	x		x			x	x	
DRM agency										
C.DRM team										
Red Cross	x	x	x	X??			x	x	x	
Marine SAR	x									
Maritime Administration	x				x	x		x		

Figure 19. Agencies indicated communication technologies they regularly used to exchange information with fishers

Following the consultation workshop (Figure 20), the site visits to Soufriere and Scotts Head (Figure 21), provided opportunity for interaction with fishers and observation of conditions in coastal communities.

Figure 20 Agencies attending the consultation workshop

Figure 21 Adjacent fishing sites Soufriere and Scotts Head

Several of the points from these visits were reflected in the above lists, but we also noted them at Soufriere and Scotts Head, which are combined for reporting due to similarities in information:

- Area covered is serviced by the St Marks Fisherfolk and Tourism Cooperative and the Soufriere-Scotts Head Marine Reserve (SSMR) Local Area Management Authority (LAMA)
- The cooperative is not currently engaged in EW and ER planning, programmes or projects
- Co-op can bring in VHF radios duty free; suggested LAMA could offer a visible signal of sea state in the areas where boats are just as dangerous swimming areas are flagged
- Fishers fish FADs and open water mostly; up to 60 miles from land but typically up to 30 miles
- Cell phone range about 15-20 miles from Dominica, but most then switch to Martinique for coverage beyond by using MTT brand dual SIM cell phone
- None said they carried smart phones to sea; those with smart phones used them on land to check weather before fishing; took basic phone to sea in bucket or otherwise secured
- Was shown Samsung Galaxy 7 phones used to get info before fishing, but few have them
- Fishers who said they checked marine weather sites online could not name any of them
- Problems of vessel loss at sea were seldom to lack of weather warning; mostly due to bad seamanship and safety practices, so little interest in FEWER except for enhancing SAR
- Several fishers wanted French one-touch distress device for summoning SAR that they had seen, no clear technical description, but believed to be EPIRB
- Several fishers aware of VHF radio use from Fisheries Division training but say NTRC application process, cost of licence, and no clear understanding of why it is complicated all deter them
- Said that Coast Guard was deterring VHF use for fear of communication in illegal activity
- Fishers with VHF keep them hidden as most are not licenced due to perceived cost and process; Fisheries Division says that <5% of the fleet has licensed VHF, but highly uncertain estimate
- One fisherman claimed to always carry a fully charged VHF radio as an emergency only as few fishermen to communicate with at sea using VHF, but he can call the signal station/port
- Fishermen typically have Coast Guard and a handful of other fishers in their cell phone contacts
- Whether they have phone number or not they signal or shout out to another fisher close by when they are leaving a fishing area, especially if fishing around a FAD
- They know when to expect fishers back and they call around on land to mount own fishers SAR
- Wave height and wind speed are the two main measurements that determine if to fish or not
- When forecast says seas in open water are about 2.5m or over they sometimes stay in
- Most fishers listen to the weather news at some point and share news by word of mouth

- Some fishers say they heed small craft advisories to exercise caution but most said they made their own observations and went to see without much attention to weather news
- Fishers say they are advised to make free call to weather hotline of Met Service before going fishing but few do so unless it is to confirm their own perceptions of a weather threat
- Fishers get lost at sea due to squalls and poor visibility despite carrying GPS; either do not know how to properly use GPS, or do not trust the GPS to give correct direction and do not follow it

While there are very obvious technical communication constraints the greatest challenge is developing a genuine demand for a FEWER ICT solution given the current limited interest.

6 RESPONSE CAPABILITY

Contacts agreed that an ICT solution for ER should be more straightforward than for EW. This is primarily because much ER data and information can be obtained locally from existing resources with a longer life span. Points included:

- ODM was accepted by the fishing industry as a credible source of EW and ER information
- Public perception of risks was heightened by recent experience resulting in a responsive state
- There was relatively little concern about false alarms regarding hydro-met hazards to fishers
- Red Cross CDRT are treated as part of ODM's ER network so the integration is seamless
- No safe havens for fishing vessels shelter in Dominica except for Marigot perhaps
- Different categories of hurricane shelter; some for during, others for after event
- Can maintain community contact lists at the co-op; this would assist Red Cross and other in ER
- More communities were being mapped for vulnerabilities and response teams being trained
- Joint exercises to maintain capacity and readiness were regularly planned and executed; the fishing industry was not specifically targeted in them but many were in coastal communities
- Fishing cooperatives were currently low in capacity concerning climate and disaster awareness
- Fishers may find that the co-operative working hours are an obstacle to responsive self-help
- Damage assessment and many other forms and guidance used by ODM could be incorporated into a smart phone app, noting that Red Cross also uses an app for its internal management
- 185 reports of vessel damage following Erika, much due to floating or submerged trees
- Initial damage of $1.7 million reduced to $500,000 after verification process
- Recommends Fisheries Division develops information kits and ER packs for fishers
- ODM in favour of ER app including Damage and Needs Assessment (DANA) form and way to submit info electronically; standard DANA forms are part of ER training

There already exists a set of resources and communication systems for ER, but what is needed most is better communication to reach the fishing industry specifically, especially when a hazard only impacts a few coastal communities or is mainly felt at sea.

7 COLLABORATION AND CONCLUSIONS

This final section of the country visit findings addresses views on the expected FEWER memorandum of understanding (MOU) and the perspectives of contacts on the main elements of a FEWER solution.

The requirement to develop a draft FEWER inter-agency MOU was discussed especially at the national consultation workshop. Contacts were reminded of the fairly standard components of a MOU (Figure 22) as well as the responsibilities to develop, test, implement and sustain FEWER (Figure 23).

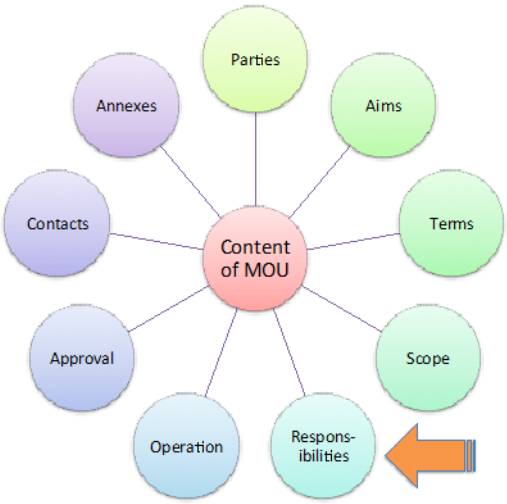


Figure 22. MOUs have a fairly standard content and format

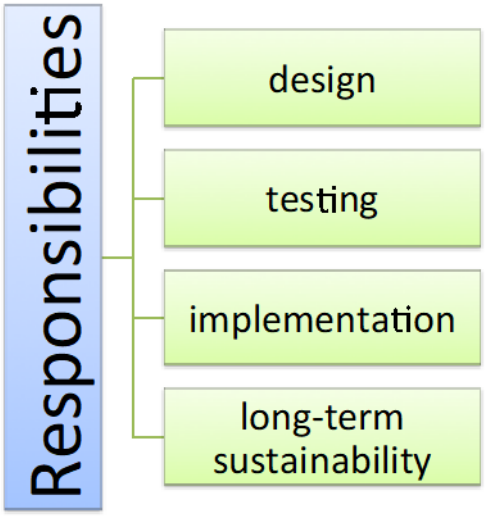


Figure 23. MOU responsibilities are spelled out for FEWER

To ensure that the concept was clear a few agencies were asked to indicate responsibility preferences at the national level, given that regional level roles were relatively clear in formal organisational mandates. The responses included:

- Fisheries Division — Ultimate authority for fisheries; multi-mode communication support; co-design information; fisheries-ICT training; resource mobilisation
- Fisherfolk organisation — Outreach by "translating" technical information for fishers to better understand; Identify innovative ICT fishers
- Met Services — Configure initial alerts; assist in managing and using CAP; use of tools and new training for marine advisories specific to solution providing and validating forecasts
- Red Cross — Assist training; emergency response communication; first aid and CPR app available
- Maritime Administration — Ensure following of applicable rules, best practices e.g. for training fisherfolk in radio operation; certification (in collaboration with NTRC licence); meeting safety requirements
- NTRC — Licensing (conditions, application, fee); application of USF; regulations and standards

ODM has no MOU with any agency, but needs to replace informal arrangements with MOUs in the future to reflect best practices. MOUs must be short and simple; 2-3 pages.

Contacts provided substantial valuable information for the co-design of the FEWER solution in ways that fit the particular needs of the Dominica fishing industry and MHEWS. They were reminded of next steps.

8 APPENDICES

Appendix 1. Announcement flyer

UWI

PPCR PILOT PROGRAM FOR CLIMATE RESILIENCE

IDB Inter-American Development Bank

CRFM Caribbean Regional Fisheries Mechanism

Fisheries Early Warning & Emergency Response

What aim guides Fisheries Early Warning and Emergency Response (FEWER)?

FEWER aims to: "reduce the risks to fishers associated with climate change and variability by developing … early warning and emergency response … for fishers in the Caribbean, including training"

Where and when will FEWER be developed with your valuable input?

The project countries are: (1) Dominica (2) Grenada (3) Saint Lucia (4) St Vincent and the Grenadines
The period of the project is: from February 2017 to June 2018 … lots to achieve in just over one year

What types of hazards and risks will be included in FEWER?

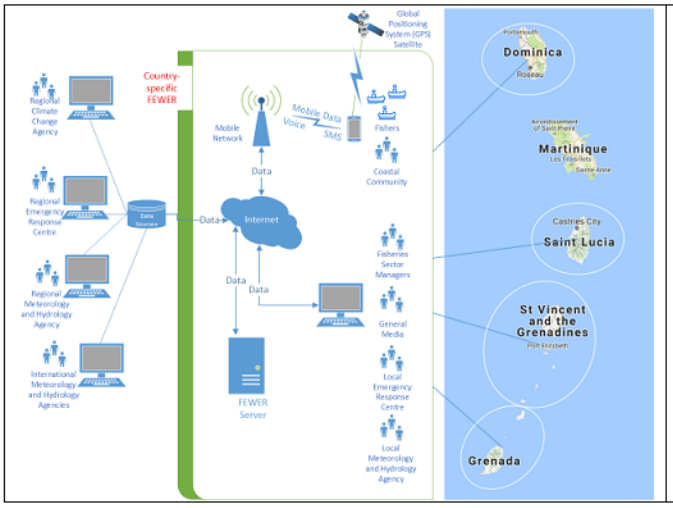
Rough seas, sea surge, high winds, flooding etc. (e.g. from storms, hurricanes)
Other hazards due to any change and variability in climate likely to affect fishers

Climate hazards

Why should this interest you? How will fisherfolk benefit?

Fewer delays or confusion because of clear communication
Fewer losses and anguish because you heed early warning
Fewer post-disaster issues because of emergency response
Fewer uninformed fisherfolk because you share knowledge
Fewer questions to be asked because it is **your own** FEWER

Fewer risks for fishers and other stakeholders



Who will help to develop the FEWER with you?

ICT4Fisheries Consortium

- Caribbean ICT Research Programme
- Caribbean Network of Fisherfolk Organisations
- UWI Cave Hill - Centre for Resource Management & Environmental Studies
- UWI St. Augustine - Department of Computing and IT
- University of Cape Town - Small-scale Fisheries and Coastal Research Group

Working closely with

- Fisheries stakeholders of all types interested in FEWER
- Secretariat of the Caribbean Regional Fisheries Mechanism
- National Fisheries Divisions/Departments in the 4 countries
- National and regional disaster, coastal and climate agencies
- National authorities responsible for finance and planning

Information & Communication Technology (ICT)?

- Smart phone apps, desktop computer software, devices
- People linked to fishing communities trained to use ICT

FOR FISHERFOLK, THEIR FAMILIES AND OTHERS IN FISHERIES…

How can you help to make your FEWER the best that it can be?

- **Tell us** about the climate-related hazards that put you at risk and what you do
- **Be informed** on early warning and emergency response — we will give you info
- **Share** your information on normal everyday communication in your fisheries
- **Show and tell** us about how you have actually communicated in past disasters
- **Tell** ICT4Fisheries Consortium and others what worked well and what did not
- **Disclose** your views on what you would like to see in a FEWER that you make
- **Talk** to us a lot about why, how, when, where and with whom you communicate
- **Suggest** who should take part in a working FEWER, and their responsibilities
- **Participate** in the national consultations and site visits that will soon be organised
- **Keep in touch** with fisherfolk organisations and community leaders on FEWER
- **Make your input** into a FEWER that would be fairly simple and easy to maintain
- **Take part** in the actual design of a FEWER, testing and training on how to use it

What will be delivered in the FEWER? What to expect at the end?

- Consultation and discussion — so there is a written record of what people say on EW and ER
- Consultation and discussion — so all people know what, and what not, to expect from FEWER
- Information on EW and ER — so fisherfolk especially are clear on what is involved in FEWER
- Site visit to a fishing community — so that practical appreciation has informed FEWER design
- Country-specific FEWER proposal — so that each country has a FEWER to meet its needs
- Country-specific FEWER proposal — to also be clear on the gaps and challenges that exist
- Development of mobile app — for a smartphone-based means of early warning, response
- Development of desktop app — to complement mobile app and link land and sea stakeholders
- Hands-on training sessions — so there is practical experience and people who can carry on
- Linking various organisations — so a communication network can be developed for FEWER
- Manuals and training material — so the work on FEWER can continue long after project ends
- Memorandum of agreement — first draft developed among participants to continue FEWER

How to find out more about your FEWER and the project plans?

Contact the Secretariat of the Caribbean Regional Fisheries Mechanism (Email: secretariat@crfm.int)

FEWER is implemented under the Caribbean Regional Track of the Pilot Programme for Climate Resilience (PPCR) with grant funding from the Inter-American Development Bank (IDB). It is executed by The University of the West Indies, Mona through its Mona Office for Research and Innovation (MORI) in partnership with the Caribbean Regional Fisheries Mechanism (CRFM). For further information contact CRFM Secretariat.

Appendix 2. Meetings notices

UWI PPCR IDB Inter-American Development Bank CRFM Caribbean Regional Fisheries Mechanism

Fisheries **E**arly **W**arning & **E**mergency **R**esponse

Roseau morning meeting

Dominica project inception and scoping meeting
09:00am – 12:30pm Wednesday 5 April 2017
Fisheries Division conference room

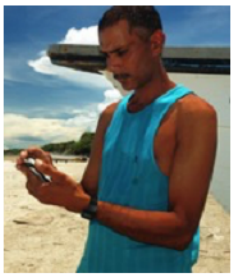
Agenda

1. Project overview, aims and objectives from scoping to design to training
2. Problems of climate hazards in fisheries, with EW and ER experiences
3. Most feasible information and communication technology (ICT) solutions
4. Arrangements among stakeholders to sustain benefits after the project

Refreshments will be served

Soufriere 4:30pm and Scotts Head 5:30pm afternoon event

Soufriere and Scotts Head scoping meeting
4:30pm Soufriere & 5:30pm Wednesday 5 April 2017
By the shore where fishermen usually gather



Agenda

1. Project overview, aims and objectives from scoping to design to training
2. Problems of climate hazards in Dominica, with EW and ER experiences
3. Most feasible information and communication technology (ICT) solutions
4. Arrangements at community level to sustain benefits after the project

Refreshments will be served

For further information on the FEWER project or these meetings email patrick.mcconney@gmail.com

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Appendix 3. Checklist for early warning systems

The checklist on developing early warning systems was developed as a contribution to the Third International Conference on Early Warning by ISDR[4].

1. Risk Knowledge

1.1. Organizational Arrangements Established

- Key national government agencies involved in hazard and vulnerability assessments identified and roles clarified (e.g. agencies responsible for economic data, demographic data, land-use planning, and social data).
- Responsibility for coordinating hazard identification, vulnerability and risk assessment assigned to one national organization.
- Legislation or government policy mandating the preparation of hazard and vulnerability maps for all communities in place.
- National standards for the systematic collection, sharing and assessment of hazard and vulnerability data developed, and standardized with neighboring or regional countries, where appropriate.
- Process for scientific and technical experts to assess and review the accuracy of risk data and information developed.
- Strategy to actively engage communities in local hazard and vulnerability analyses developed.
- Process to review and update risk data each year and include information on any new or emerging vulnerabilities and hazards established.

1.2. Natural Hazards Identified

- Characteristics of key natural hazards (e.g. intensity, frequency and probability) analyzed and historical data evaluated.
- Hazard maps developed to identify the geographical areas and communities that could be affected by natural hazards.
- An integrated hazard map developed (where possible) to assess the interaction of multiple natural hazards.

1.3. Community Vulnerability Analyzed

- Community vulnerability assessments conducted for all relevant natural hazards.
- Historical data sources and potential future hazard events considered in vulnerability assessments.

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[4] UNISDR 2006. Developing Early Warning Systems: A Checklist. Third International Conference on Early Warning *From concept to action*. 27 – 29 March 2006. Bonn, Germany. http://www.unisdr.org/files/608_10340.pdf. Last accessed 28 May 2017.

- Factors such as gender, disability, access to infrastructure, economic diversity and environmental sensitivities considered.
- Vulnerabilities documented and mapped (e.g. people or communities along coastlines identified and mapped).

1.4. Risks Assessed

- Interaction of hazards and vulnerabilities assessed to determine the risks faced by each region or community.
- Community and industry consultation conducted to ensure risk information is comprehensive and includes historical and indigenous knowledge, and local information and national level data. Activities that increase risks identified and evaluated.
- Results of risks assessment integrated into local risk management plans and warning messages.

1.5. Information Stored and Accessible

- Central 'library' or GIS database established to store all disaster and natural hazard risk information.
- Hazard and vulnerability data available to government, the public and the international community (where appropriate).
- Maintenance plan developed to keep data current and updated.

2. Monitoring and Warning Service

2.1. Institutional Mechanisms Established

- Standardized process, and roles and responsibilities of all organizations generating and issuing warnings established and mandated by law.
- Agreements and interagency protocols established to ensure consistency of warning language and communication channels where different hazards are handled by different agencies.
- An all-hazard plan to obtain mutual efficiencies and effectiveness among different warning systems established.
- Warning system partners, including local authorities, aware of which organizations are responsible for warnings.
- Protocols in place to define communication responsibilities and channels for technical warning services.
- Communication arrangements with international and regional organizations agreed and operational.
- Regional agreements, coordination mechanisms and specialized centers in place for regional concerns such as tropical cyclones, floods in shared basins, data exchange, and technical capacity building.
- Warning system subjected to system-wide tests and exercises at least once each year.
- A national all-hazards committee on technical warning systems in place and linked to national disaster management and reduction authorities, including the national platform for disaster risk reduction.
- System established to verify that warnings have reached the intended recipients.
- Warning centers staffed at all times (24 hours per day, seven days per week).

2.2. Monitoring Systems Developed

- Measurement parameters and specifications documented for each relevant hazard.
- Plans and documents for monitoring networks available and agreed with experts and relevant authorities.
- Technical equipment, suited to local conditions and circumstances, in place and personnel trained in its use and maintenance.
- Applicable data and analysis from regional networks, adjacent territories and international sources accessible.
- Data received, processed and available in meaningful formats in real time, or near-real time.
- Strategy in place for obtaining, reviewing and disseminating data on vulnerabilities associated with relevant hazards.
- Data routinely archived and accessible for verification and research purposes.

2.3. Forecasting and Warning Systems Established

- Data analysis, prediction and warning generation based on accepted scientific and technical methodologies.
- Data and warning products issued within international standards and protocols.
- Warning analysts trained to appropriate international standards.
- Warning centers equipped with appropriate equipment needed to handle data and run prediction models.
- Fail-safe systems in place, such as power back-up, equipment redundancy and on-call personnel systems.
- Warnings generated and disseminated in an efficient and timely manner and in a format suited to user needs.
- Plan implemented to routinely monitor and evaluate operational processes, including data quality and warning performance.

3. Dissemination and Communication

3.1. Organizational and Decision-making Processes Institutionalized

- Warning dissemination chain enforced through government policy or legislation (e.g. message passed from government to emergency managers and communities, etc.).
- Recognized authorities empowered to disseminate warning messages (e.g. meteorological authorities to provide weather messages, health authorities to provide health warnings).
- Functions, roles and responsibilities of each actor in the warning dissemination process specified in legislation or government policy (e.g. national meteorological and hydrological services, media, NGOs).
- Roles and responsibilities of regional or cross border early warning centers defined, including the dissemination of warnings to neighboring countries.
- Volunteer network trained and empowered to receive and widely disseminate hazard warnings to remote households and communities.

3.2. Effective Communication Systems and Equipment Installed

- Communication and dissemination systems tailored to the needs of individual communities (e.g. radio or television for those with access; and sirens, warning flags or messenger runners for remote communities).

- Warning communication technology reaches the entire population, including seasonal populations and remote locations.
- International organizations or experts consulted to assist with identification and procurement of appropriate equipment.
- Multiple communication mediums used for warning dissemination (e.g. mass media and informal communication).
- Agreements developed to utilize private sector resources where appropriate (e.g. amateur radios, safety shelters).
- Consistent warning dissemination and communication systems used for all hazards. Communication system is two-way and interactive to allow for verification that warnings have been received.
- Equipment maintenance and upgrade program implemented and redundancies enforced so back-up systems are in place in the event of a failure.

3.3. Warning Messages Recognized and Understood

- Warning alerts and messages tailored to the specific needs of those at risk (e.g. for diverse cultural, social, gender, linguistic and educational backgrounds).
- Warning alerts and messages are geographically-specific to ensure warnings are targeted to those at risk only.
- Messages incorporate the understanding of the values, concerns and interests of those who will need to take action (e.g. instructions for safeguarding livestock and pets).
- Warning alerts clearly recognizable and consistent over time and include follow-up actions when required.
- Warnings specific about the nature of the threat and its impacts.
- Mechanisms in place to inform the community when the threat has ended.
- Study into how people access and interpret early warning messages undertaken and lessons learnt incorporated into message formats and dissemination processes

4. Response Capability

4.1. Warnings Respected

- Warnings generated and distributed to those at risk by credible sources (e.g. government, spiritual leaders, respected community organizations).
- Public perception of natural hazard risks and the warning service analyzed to predict community responses.
- Strategies to build credibility and trust in warnings developed (e.g. understanding difference between forecasts and warnings).
- False alarms minimized and improvements communicated to maintain trust in the warning system.

4.2. Disaster Preparedness and Response Plans Established

- Disaster preparedness and response plans empowered by law.
- Disaster preparedness and response plans targeted to the individual needs of vulnerable communities (Increasingly it is possible to target vulnerable individuals).
- Hazard and vulnerability maps utilized to develop emergency preparedness and response plans.
- Up-to-date emergency preparedness and response plans developed, disseminated to the community, and practiced.

- Previous disaster events and responses analyzed, and lessons learnt incorporated into disaster management plans.
- Strategies implemented to maintain preparedness for recurrent hazard events.
- Regular tests and drills undertaken to test the effectiveness of the early warning dissemination processes and responses.

4.3. Community Response Capacity Assessed and Strengthened

- Community ability to respond effectively to early warnings assessed.
- Response to previous disasters analyzed and lessons learnt incorporated into future capacity building strategies.
- Community-focused organizations engaged to assist with capacity building.
- Community and volunteer education and training programs developed and implemented.

4.4. Public Awareness and Education Enhanced

- Simple information on hazards, vulnerabilities, risks, and how to reduce disaster impacts disseminated to vulnerable people, communities and decision-makers.
- Community educated on how warnings will be disseminated, and which sources are reliable and how to respond to different types of hazards after an early warning message is received.
- Community trained to recognize simple hydro-meteorological and geophysical hazard signals to allow immediate response.
- On-going public awareness and education built in to school curricula from primary schools to university.
- Mass media and folk or alternative media utilized to improve public awareness.
- Public awareness and education campaigns tailored to the specific need of each audience (e.g. children, vulnerable people, emergency managers, and media).
- Public awareness strategies and programs evaluated at least once per year and updated where required.

Appendix 4. List of contacts

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

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