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GRENADA CONSULTATION REPORT:
Fisheries Early Warning and Emergency Response

CRFM Secretariat
2018

Grenada 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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GRENADA CONSULTATION REPORT: FISHERIES EARLY WARNING AND EMERGENCY RESPONSE

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CONTENTS

ACRONYMS AND ABBREVIATIONS

ADMIN	Administrator
APP	Application (related to application program interface)
CAP	Common Alerting Protocol
CARICOM	Caribbean Community
CC4FISH	Climate Change Adaptation in the Eastern Caribbean Fisheries Sector (Project)
CCA	Climate Change Adaptation
CCCCC	Caribbean Community Climate Change Centre
CDEMA	Caribbean Disaster Emergency Management Agency
CDRT	Community Disaster Response Team
CHARIM	Caribbean Handbook on Risk Information Management
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
CTIC	Caribbean Tsunami Information Centre
DANA	Damage and Needs Assessment
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DVRP	Disaster Vulnerability Reduction Project
EAF	Ecosystem Approach to Fisheries
ECHO	European Commission Humanitarian Aid
ECLAC	Economic Commission for Latin America and the Caribbean
ECTEL	Eastern Caribbean Telecommunications Authority
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
GRENCODA	Grenada Community Development Agency
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
Met	Meteorological
MHEWS	Multi-Hazard Early Warning Systems
MORI	Mona Office for Research and Innovation
MOU	Memorandum of Understanding
MU	Maritime Unit
NaDMA	National Disaster Management Agency
NAWASA	National Water and Sewerage Authority
NTRC	National Telecommunications Regulatory Commission

PGIS	Participatory Geographic Information Systems
PPCR	Pilot Program for Climate Resilience
RDS	Radio Data Service
SAME	Specific Area Message Encoding
SAR	Search and Rescue
SocMon	Socio-economic Monitoring for Coastal Management (Global Programme)
SRS	Software Requirements Specification
TNC	The Nature Conservancy
UNDP	United Nations Development Programme
VCA	Vulnerability and Capacity Assessments
VHF	Very High Frequency (marine radio)
WMO	World Meteorological Organization

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 (CIF), 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 Grenada from 18-20 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, as shown in (Figure 2), to accommodate multiple actors, relationships and technologies.

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 for reference along with endnotes.

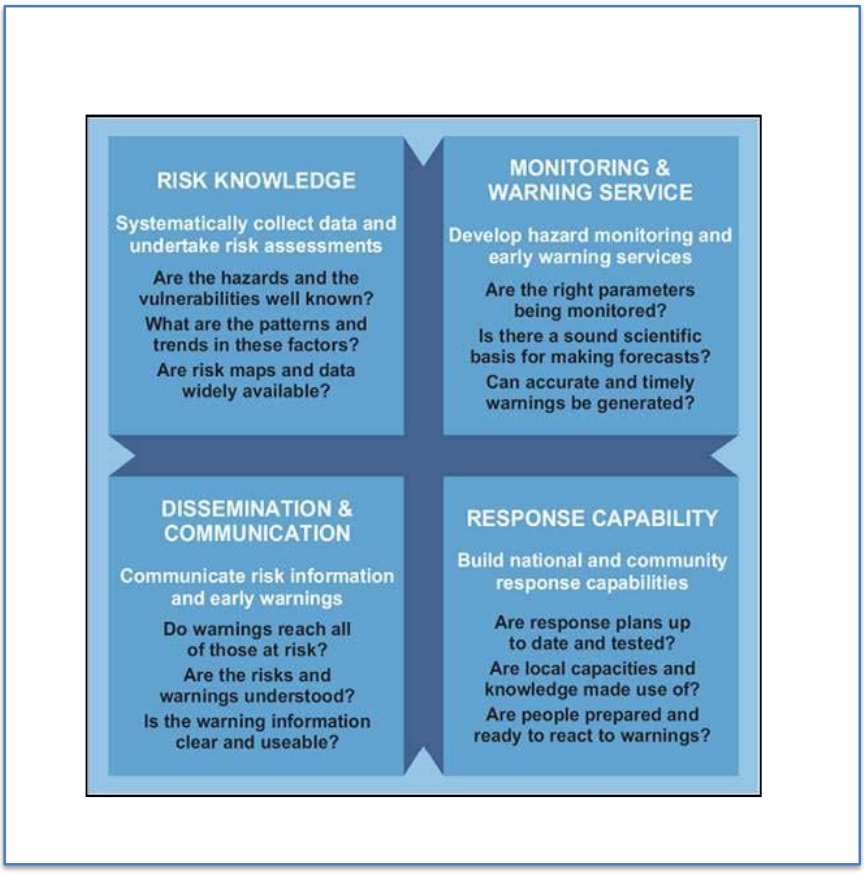


Figure 1. EWS are underpinned by governance

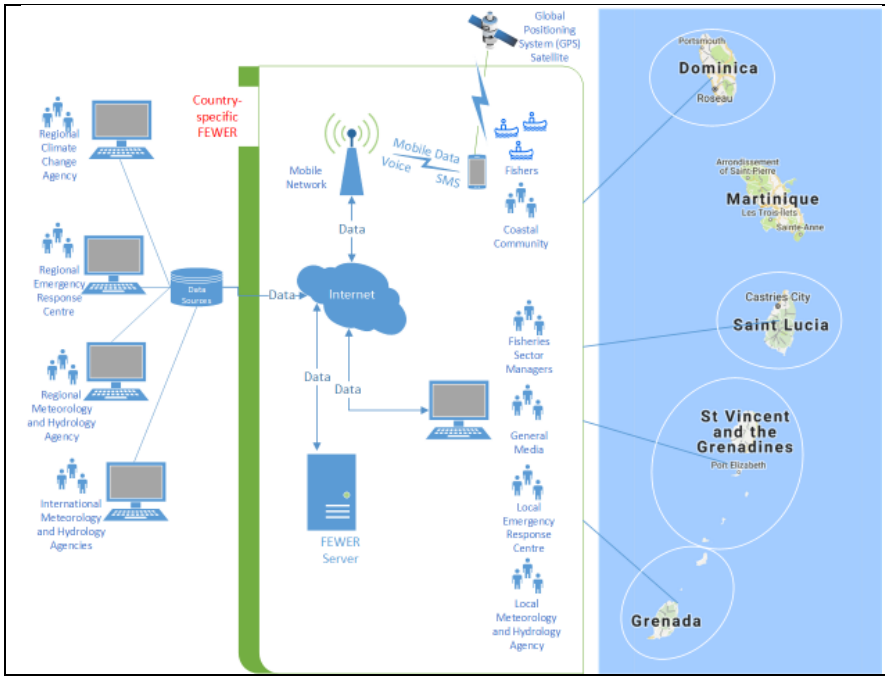


Figure 2. FEWER schematic for country specific solutions

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 Grenada, 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 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 St George's) and following site visit (in Grenville) were well publicised (Appendix 2) with the assistance of the liaisons. An additional site visit, to Gouyave, was also undertaken. Site visit locations were selected using criteria in consultation with the fisheries authority. The consultants prepared to use and adapt the checklist (Appendix 3) for context-specific analysis.

Table 1. National consultation liaisons

Liaison	Affiliation
Francis Calliste	Fisheries authority
Luis Acosta	National fisherfolk

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 specialists Kevon Andrews and Cathy Ann Radix. Key informant interviews and site visit to Gouyave on the first day guided information exchange in the national consultation workshop held at the Fisheries Division in St George's on the morning of the second day. Chief Fisheries Officer Crafton Isaac opened the consultation. The

afternoon visit was to Grenville. The sites visited are shown in Figure 3. The consultants provided their own 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 Grenada were Gouyave, St. George's and Grenville

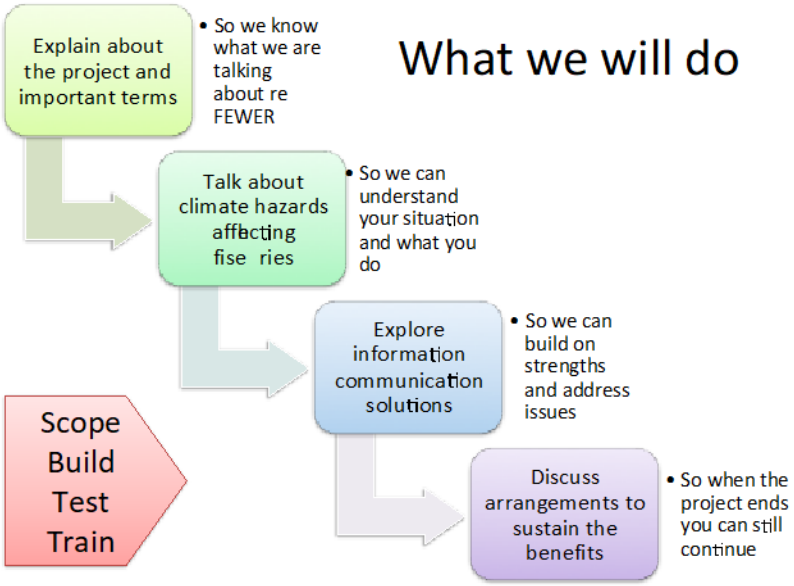


Figure 4. Organisation of the national workshop

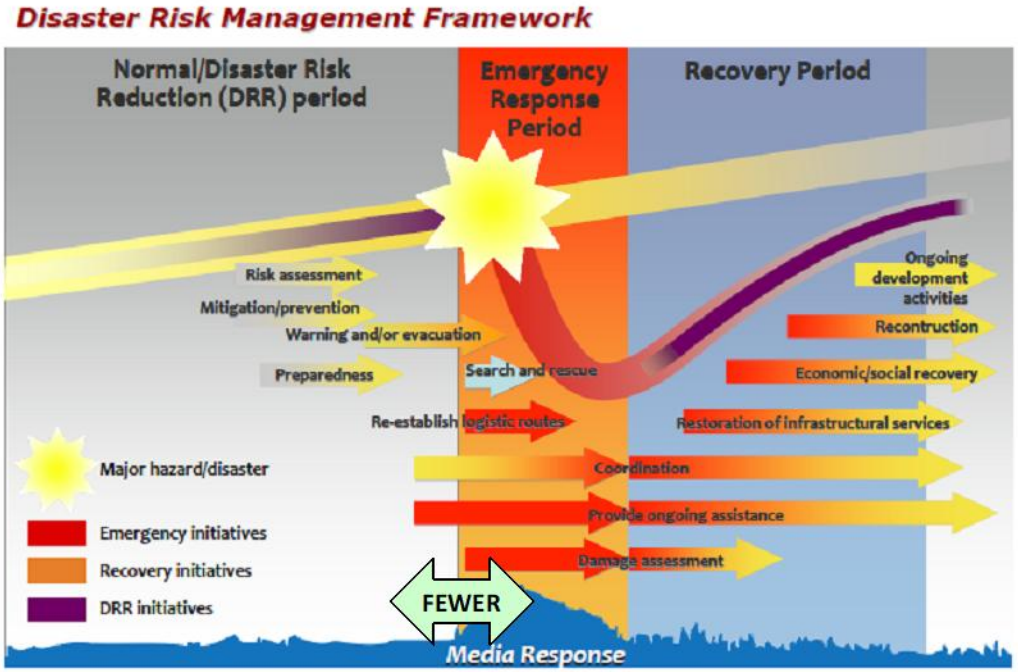
2.2 Organisation

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.



Source: Disaster Risk Management Cycle (DRMC) Diagram (modified from TorqAid; http://www.torqaid.com/default.asp).

Figure 5. FEWER at the interface between EW and ER

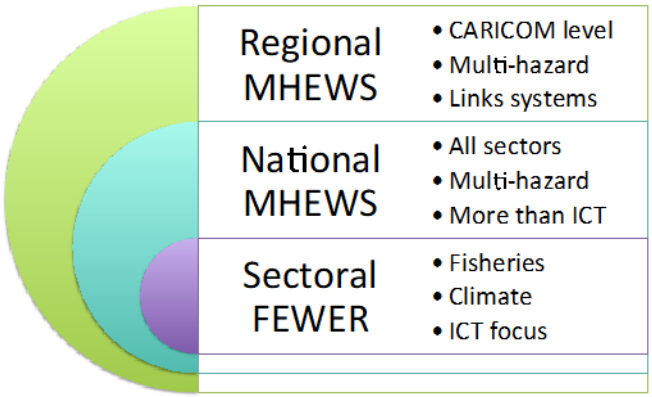


Figure 6. FEWER as a part of a larger multi-hazard and cross-sectoral, nationally to regionally networked EWS

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].

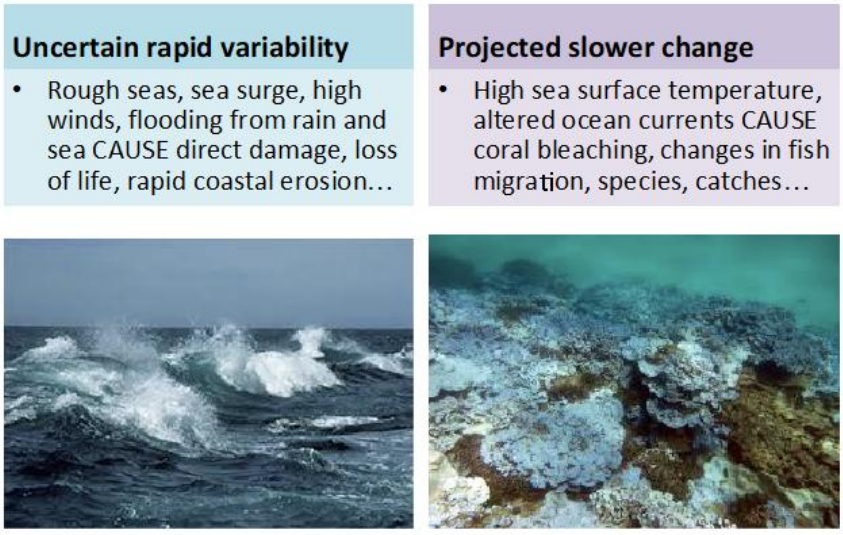


Figure 7. FEWER focuses mainly on rapid onset climate hazards but slow onset changes cannot be ignored in longer term fisheries plans

[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.

Normal communication among, and with, fishers about weather and hazards in fishing and in adapting

Urgent communication among, and with, fishers when a hazard threatens and response to impacts

Desirable communication among, and with, fishers about better early warning and emergency response

Some key questions for you:

1. What hazards talked about?
2. What main sources of info?
3. What agencies are involved?
4. Who mostly talks to whom?
5. Talk how often from where?
6. When do you usually talk?
7. Using what types of tech?
8. How does info best spread?
9. What strength to build on?
10. What weakness to tackle?

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

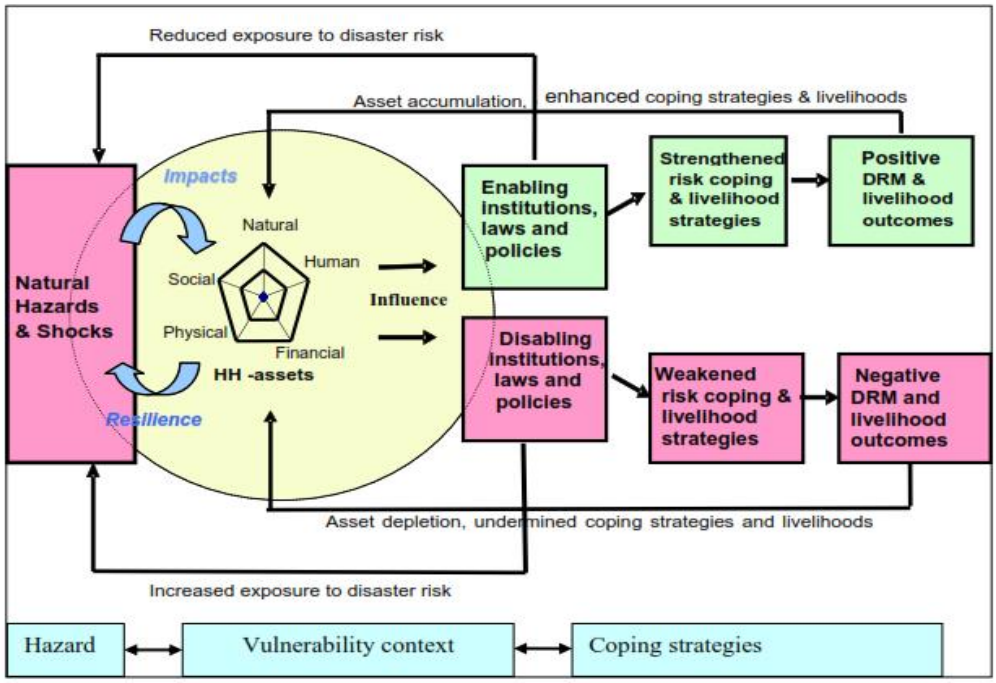


Figure 10 Disaster practices are taken in the context of livelihood assets, institutions and strategies (Source: Baas and others 2008)

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).

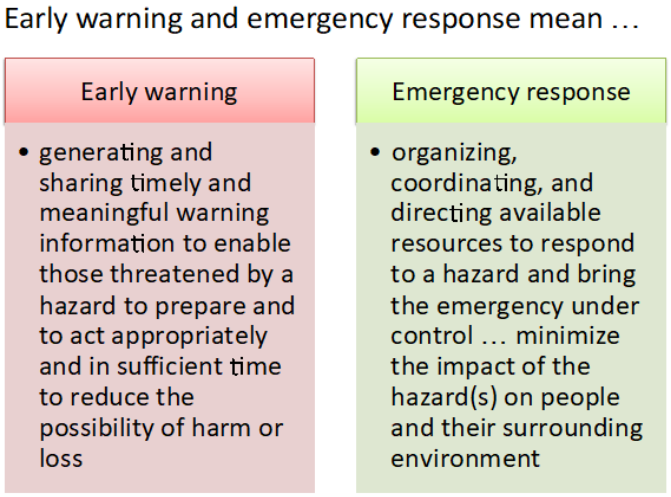


Figure 11 Early warning and emergency response explained

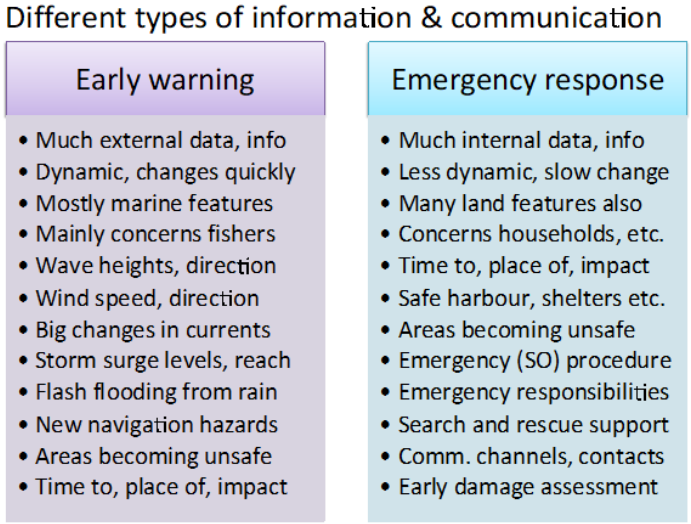


Figure 12 EW and ER differ in information characteristics

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:

- National Disaster Management Agency (NaDMA) 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 NaDMA with a clear mandate and jurisdiction over disaster-related matters and is adequate for the FEWER, and multi-stakeholder engagement was based on NaDMA's authority
- MOUs with agencies included in the national MHEWS are not customary, but a simple FEWER MOU would be acceptable
- 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 NaDMA 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.

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					x
- Sea swells, in open ocean			x		
- Wind waves, in open ocean				x	
- High surf, mainly near to shore				x	
High wind, maybe >20 knots				x	
Wind direction and speed			x		
Currents, speed and direction				x	
Storm surge, how high and far				x	
Rain flood, flash flooding likely					x
Water temp., coral bleaching?		x			
Visibility, hazy atmosphere					x
Fish kill probability			x		

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
Float plan; prior fisheries info				x	

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:

- 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
- Resurgence in fish aggregating devices (FADs) assists safety at sea as well as improve incomes
- Much fish now comes from offshore (20-40 miles) FADs, so know where fishers go
- 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 expertise mainly with Physical Planning; Fisheries Division currently has none
- 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)
- Flood mapping is on Caribbean Handbook for Risk Information Management (CHARIM) web site; little else is currently generated by Physical Planning that is of direct relevance to FEWER
- Land Use section of Ministry of Agriculture and The Nature Conservancy (TNC) have GIS capacity
- Physical Planning in process of building GeoNode services via DVRP; ~75% done but terrestrial; will be open data when done, but users will need to pay for analytical services
- 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), with some larger (10-15m) vessels. The small boats, and main intended beneficiaries of FEWER, are 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).

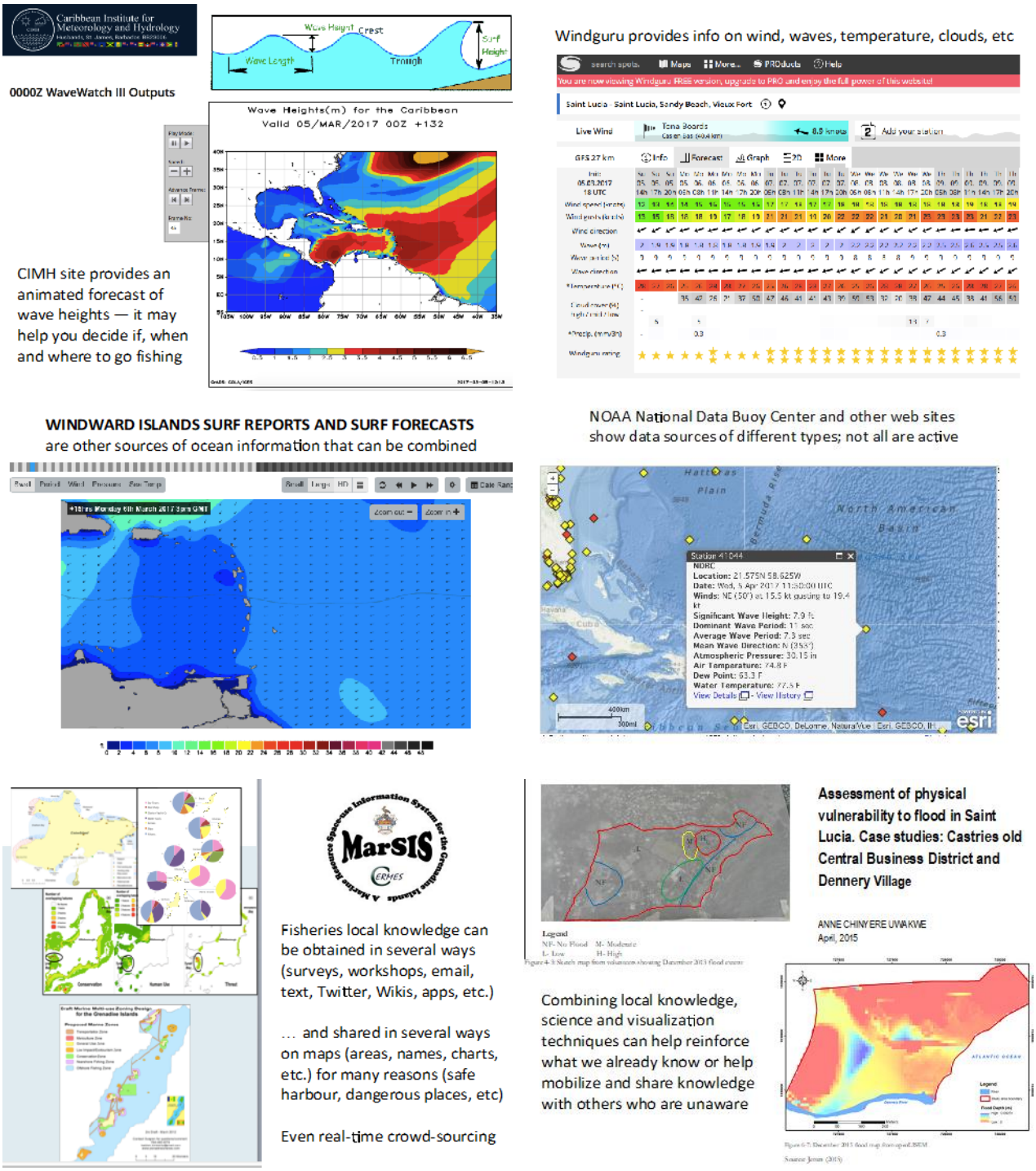


Figure 15. Sources and visualisations of hazard monitoring information form the basis of early warning and emergency response

Referring to the EWS checklist, and ignoring redundancy with points addressed previously under risk, a critical finding was that Grenada 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. NaDMA recently lost some in-house CAP

capacity due to staff movement, but retains the server. FEWER proposals need to take CAP into account. The national fisherfolk body is newly developed with a few primary (fish landing site) organisations.

Other points, many made in key informant interviews and the national consultation workshop, were:

- NaDMA's institutional mechanisms for fisheries-related monitoring and warning are fairly adequate, but a more targeted effort such as by FEWER would be welcomed for fishing industry
- Met Services has its own forecasters (7) and offers 24-hour service, but with no phone hotline for out-going or in-coming communication; gets info from Trinidad for severe weather forecasts
- Many online products presented in the workshop are used regularly by Met Service forecasters
- Met Services uses WMO standards for terms such as swells, rough seas etc. to be consistent, and absence of such rigorous consistency is one of the concerns with citizen data and advisories
- Major concern is the equivalence of observations for reliability, validity and use of terms
- Discussed visualisation of sea conditions paired with meteorological, layman and fisher terms in an app perhaps for reference use and possible crowdsourcing of real time marine data at sea
- Met Services maintains its own archive folder of impacts from significant past weather events to which they can compare current weather conditions to improve forecasting; little of it is marine
- Forecasters do not rely greatly on Met buoys to validate model-run, sea-state forecasts
- Tide gauge at Prickly Bay was/is part of IOC array; some sensors in rivers, but none for EW use
- River sensors are under management of Land Use and NAWASA but just for data collection
- Met Service forecasters get more personal than formal requests from fishers for hydro-met info
- No formal move towards impact forecasting, but more forecasters are inclined that way
- 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
- NaDMA is currently discussing arrangements for CAP server and replacement of IT officer
- NTRC is Chair of NaDMA Telecommunications Committee, but staff not familiar with CAP
- Uncertainty about use and future of 50 RDS units deemed inoperable due to supplier
- Radio broadcast interrupt installed in 3 radio stations but no TV, none tested yet
- Authority for alert depends on type of hazard but it seems that all go through NaDMA
- 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
- Feedback from public on alerts is ad hoc but some measure of reach achieved
- Various reports document MHEWS issues being addressed in regional to national linkages
- NaDMA wants FEWER to be integrated with their tsunami early warning system
- Need a glossary of fisher equivalent terms for official sea states with which to communicate
- Need 2-way communication to receive data and feedback from public when alerts issued
- The sudden rough seas that fishers experience cannot be now-cast and communicated to them
- Often the time lag between forecast conditions and these being observed leads people to think that the forecast is wrong simply because they do not consider the forecast period or updates
- False alerts via social media caused public misinformation that may have been encouraged by a lengthy delay in receiving information from an official and authoritative source
- People will use the information that is available online, often with insufficient regard for accuracy, if authorities remain silent while deciding what to do or say to the public
- Localised flash flooding has been a major problem; usually higher priority than sea state
- Need to involve people in mapping (pGIS) to increase awareness and use of disaster info
- Local knowledge and practices that provide simple useful weather information to be considered
- Public sector agencies and fishing cooperatives with regular working hours would not have the human resources to offer 24-hour support for FEWER unless a threat was imminent

The data services of CIMH, a regional organisation, were also discussed:

- Data is sent to CIMH, perhaps to appear in DEWETRA, but it is unclear to Met Services what is freely provided by CIMH in return
- DEWETRA is seldom used for normal forecasts, but some use of Wave Watch 3, and Met Services appreciates potential use of combined model forecast products and static GIS layers
- 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)
- Tool use seems to be partly the choice of individual forecasters; use NHC marine advisory, several MeteoFrance products (some under licence), CIMH rainfall etc.

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

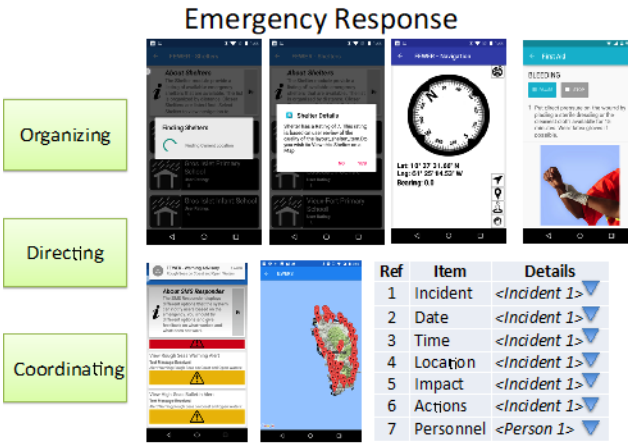


Figure 17. ICT options for features of emergency response

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 EWS checklist:

- NaDMA 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. GeoNode
- 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, and officials are unaware of plans to correct or replace the RDS units
- 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:

- Met Services forecasts for media broadcast are released at 0600, 1200, 1800
- A few fishers call, in order to interpret or verify, when marine advisories are issued but in need of feedback from sources at sea and public to validate marine forecast
- Fishers carry GPS but cannot give positions properly when asked by Coast Guard, so locational alerts at sea in FEWER may encounter problems
- Met Services would support development of an app or other means to communicate better
- Met Service has WhatsApp group and contacts of former met officers as sources of weather observations, possible alerts and validation; may be possible to expend group
- Hydro-met alerts go through NaDMA for public warnings, not direct from Met Service
- Crowdsourcing data for validation could be of interest if reliability system was assured
- Alert interrupts installed at 3 main radio stations; can expand in next phase of World Bank project to include TV
- Fishers' phones often have little credit and data services are not usually sought at sea
- 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
- Fisheries community communication is mainly by word of mouth within social networks; women included and functions 24/7
- Literacy in English does not constrain fishers understanding audio broadcasts and text messages
- NaDMA would be cautious about encouraging layman value-added impact forecasts as they may be misunderstood or be misinforming regardless of disclaimers by citizen communicators
- Most fishers are said to heed marine hazard advisories and stay ashore or go to sea cautiously
- Coast Guard accepts and expects cell phone calls from fishers in emergency. The Coast Guard encounters typical problems such as inability of the fisher to provide position, fisher's impatience with questioning to identify vessel, etc.
- Fishing partners tend to call each other when going to a fishing location that is out of cell range
- When in distress fishers use phones to call friends and relatives, only then, maybe Coast Guard
- Most fisheries distress calls are engine failure not weather related
- Fishers use phones to talk about FAD fishing success and check-out when leaving FAD locations
- FAD fishers especially call each other when any fisher is late and report the FAD at which was last seen
- NaDMA can send free SMS via informal agreement with phone service providers including threats and hazards not warranting a national alert

Arguments were heard for including marine VHF radio, which is commonly used by fishers in Grenada:

- Fisheries Division was main force behind use of marine VHF since 1990s; now well established
- Over 50% of Fishers use marine VHF; more if counting the larger vessels further offshore
- Coast Guard can improve VHF telecommunications; can lead with best available equipment
- Coast Guard does not have a marine repeater, so receives distress calls relayed by phone
- Fisheries Division has marine VHF repeaters co-located with other radio services around island

- Selected analogue rather than digital repeater partly because analogue range attenuates until lost (sounds like static) whereas digital cuts off abruptly, often at a shorter range
- Controller in storage at Fisheries Division can be used by internet access to have repeater broadcast any message at regular intervals; ideal for alerts; specifications can be provided
- Plans to have 24/7 Fisheries Division marine VHF radio monitoring were shelved
- Volunteer yachters who do their marine VHF audio blog on weather now also broadcast on band used by fishers in the morning and whenever else necessary

The NTRC is an important agency in the EWS, with some points being:

- NTRC has not sought to make marine VHF licensing attractive enough for fisher compliance
- No proficiency test is required for marine VHF; NTRC only tests ham radio operators
- NTRC does not monitor VHF use or abuse; it sends notices reminding users of good practices
- Application fee is XCD$200 with annual fee of $50; a fishing fleet licence was once suggested
- NTRC is aware marine VHF licences are not renewed once call sign is issued, but collection of licence fees is a government matter, not really under NTRC; no penalties for non-payment
- Fisheries Division should request a license waiver for fishers to regularise current non-licensing
- Fisheries Division is exempt from fees; no recent representation to NTRC to change fees or process for fisheries
- NTRC could enforce that a licence is needed before marine VHF radio can be released from Customs; NTRC may pursue an MOU to implement this
- NTRC would consider a role in a sustainability MOU but unclear what that would be
- USF supports free Wi-Fi in public spaces but unsure if any near to fish landing sites
- Fisheries Division has insufficient funds to do adequate regular marine VHF training for fishers
- Many fishers have computers in homes used by wives and children, if not themselves, and can benefit from a solution that combines smart phone, internet and VHF radio options for fishers
- Role of the fish markets in the VHF communication system for fishers was unclear; although VHF base stations are at all fish markets they are underutilized
- World Bank project to set up land UHF, not VHF, system to coordinate with police
- NaDMA has radio license for its own broadcast station but has never transmitted
- No coverage maps exist for marine VHF; but repeater locations are known by GPS
- Cell phone coverage maps from service providers, not checked for accuracy at sea
- Annual call for USF projects, and never received anything fisheries-related, but there was one for emergency phones which died

Grenada is unique among the four countries covered by the FEWER project to have a well-developed marine VHF system for its fisheries where as the others only have an estimated 5-10% use. Statistics from a few years ago revealed the following on the users (Table 3) along with users and uses (Table 4).

Table 3. Local fishing vessels using the VHF communication system

Fishery Type	Total boats in fishery	Boats with marine VHF Radio	Boats with GPS	Radio Type	Fishing Range
Longlining (Large)	110	110 VHF /20 SSB	110	25 watts Fixed	**30 – 150 NM**
Longlining (Medium)	120	120	110	25 watts Fixed	**10 – 50 NM**
Longlining (Small)	210	190	100	5 watts Hand Held	**2- 15 NM**
Trolling	150	120	60	5 watts Hand Held	**5 – 75 NM**
Hand lining	150	70	50	5 watts Hand Held	—
Other	55	5	15	5 Watts Hand Held	—
TOTAL	**760**	**580**	**410**		

(Source R. Baldeo, retired fisheries officer)

Table 4. Users ad uses of marine VHF communication in Grenada

Users of marine VHF communication	Uses of marine VHF communication
• Local fishing vessels • Fishermen homes • Fish exporters • Fish vendors • Grenada Coast Guard • Fisheries Officers • Fisheries Division Base • Fish Centres / Markets • Fisheries Control Station	• Listening to weather broadcast • Fishers talking to their family at home • Informing fish centers of vessel fishing location and ETA • Fishermen talking to fish buyers and vendors from the fishing ground. • Making announcement of vessel own position before setting longline gear. • Informing other boats of productive fishing ground. • Alerting approaching vessels of fishing gear in the water. • Reporting illegal fishing activities to fisheries Division / Coast Guard. • Reporting the sighting of foreign fishing boats. • Making distress call; requesting assistance from Coast Guard • Communication between distress vessel and vessels rendering assistance.

(Source R. Baldeo, retired fisheries officer)

Agencies likely to be involved in the FEWER solution use a variety of ICT, but much is still conventional communication (Figure 18) rather than using internet, smart phone and social media products and services. Figure 19 shows one of the waterproof, ruggedized phones favoured by many fishers.

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	o	Indi-vidual	o	x	x	o	x	o	o
Fisherfolk	x	o	x	o	x	x	o	x	x	o
Fisher Org										
Met. Service	x	o	In house	o	x	o	o	x	Maybe coming	o
DRM agency	x	x	x		x	x	x	x	x	
Red Cross	x	x	x	x	x	Land based	Has ties	x	x	o
Coast Guard/ Marine Unit	x	o	In house	o	x	x	o	x	o	o
News media										

Figure 18. Agencies indicated communication technologies they regularly used to exchange information with fishers

Figure 19. A popular ruggedized phone used by fishers, but not a smartphone

Along with the consultation workshop, the site visits to the west coast (Figure 20) and east coast (Figure 21), provided opportunity for interaction with fishers and observation of conditions in coastal communities.

Figure 20. Longline boats of different sizes on the west coast

Figure 21. East coast vessels moored at Grenville on calm day

Several of the points from these visits were reflected in the above lists, but we also noted them at Gouyave and Grenville. The main points from Gouyave were:

- Mostly use CAT, MTT, Plum and similar phones on boats; few use smart phones at sea
- When we visited a ground swell advisory from Met Services and NaDMA was in effect from midday, but no fishers said they had heard or been told about the alert; swells were evident
- One of the 2 access points for hauling boats higher was recently blocked, so more vulnerable
- Fishers and co-op seem to be doing nothing to address the haul-out blockage despite danger
- Cell phone range is about 15 miles; about 40 miles with handheld VHF; and 90 miles fixed VHF
- Some longest range longliners use HF-SSB but not enough to warrant FEWER attention
- Fishers are aware of VHF channel delivering volunteer yachters weather updates daily
- Not the practice to check phones occasionally while at sea or to chatter much on VHF
- Market has VHF base station but employees turn down squelch and volume for quiet
- Listen to marine forecast, but it does not seem critical to decision to go to sea or not
- Fishers lament that forecasts are not frequent and like idea of phone-in weather hotline
- Ignore cumbersome radio licensing requirement at NTRC once they get radio call-sign
- No enthusiasm for fishing cooperative(s) playing major role in seeking FEWER solution
- Fishers say they readily exchange phone numbers and keep in touch on land and sea

- Several fishers willing to participate in FEWER design including Gouyave leader Dexter

Points made by fishers at Grenville included:

- FAD fishers and Soubise Cooperative not well represented as many fishers are outsiders
- Fish FADs between 10 and 40 miles travel from Grenville but much is within cell coverage
- Seldom call Coast Guard for assistance as it is usually slower to respond than fellow fishers
- Marine VHF repeater allowed fisher in distress off the east coast to talk to someone in Gouyave on the west coast who then relayed info by phone to various parties all over Grenada
- Only one fisher who dealt with yachts knew of the marine VHF volunteer weather forecast
- Grenville fishers said to be younger and more tech savvy compared to other places
- Fishers like idea of billboard displayed advisories, but did not see co-ops as part of solution
- Fishers complain that market staff turn down squelch and volume on VHF base station
- Complain market staff untrained in VHF purpose and use, but co-ops not intervening to help themselves by lobbying to manage communication themselves
- Fishers claim to be unaware of funding sources, but fisheries officers say they were told
- Fishers keep phone or VHF mostly in bucket for emergency calls only; do not normally check it
- Fishers accept that they will not get alerts while at sea; have seldom needed weather info at sea
- Fishers claim that marine forecast does not usually correspond to their observations at sea but they do not communicate with Met Services about this

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:

- NaDMA is 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 NaDMA's ER network so the integration is seamless
- 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 NaDMA could be incorporated into a smart phone app, noting that Red Cross also uses an app for its internal management
- NaDMA 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).

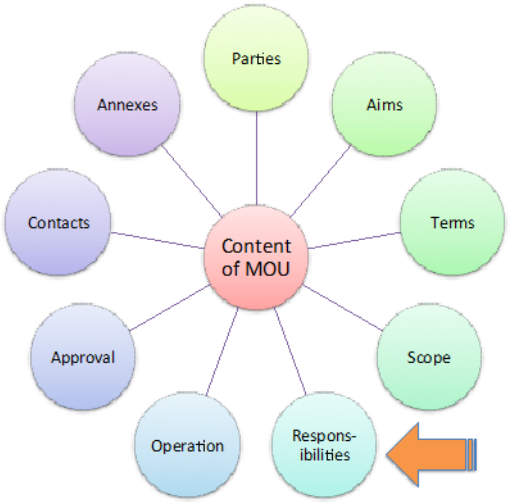


Figure 22. MOUs have a fairly standard content and format

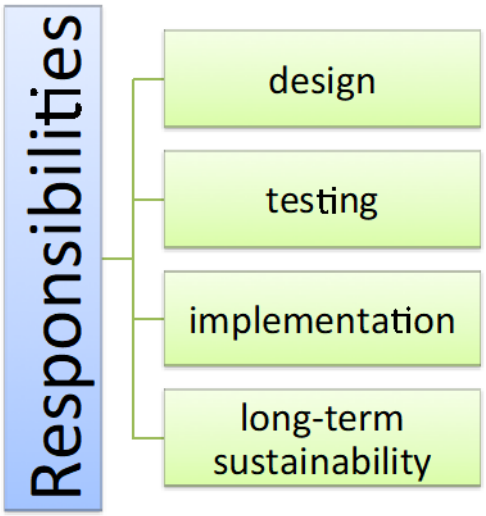


Figure 23. MOU responsibilities are spelled out for FEWER

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 authority — Disseminate information to fishers; provide equipment, training, outreach
- Fisherfolk organization — Gather information for co-design; training; inform equipment choices; be equipment suppliers; leaders serve as role models; ensure sustainability
- Met Services: provide information on EW patterns; data providing; institute feedback systems; awareness raising
- Disaster authority — Involvement in all aspects; coordination
- Red Cross — Training in DRR; fisher safety training; community mobilisation
- Coast Guard — Maritime safety and SAR training; marine advisory reinforcement; response implementation
- ICT Unit — Examine real time sharing similar to *Waze* app; training in ICT; advise on appropriate technology; participate in app development; participate in sustainability arrangements

NaDMA agreed that MOUs should be short and simple. Contacts provided substantial valuable information for the co-design of the FEWER solution in ways that fit the particular needs of the Grenada fishing industry and MHEWS. Contacts suggested that FEWER must be seen as part of the national security system for sustainability. Contacts 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?

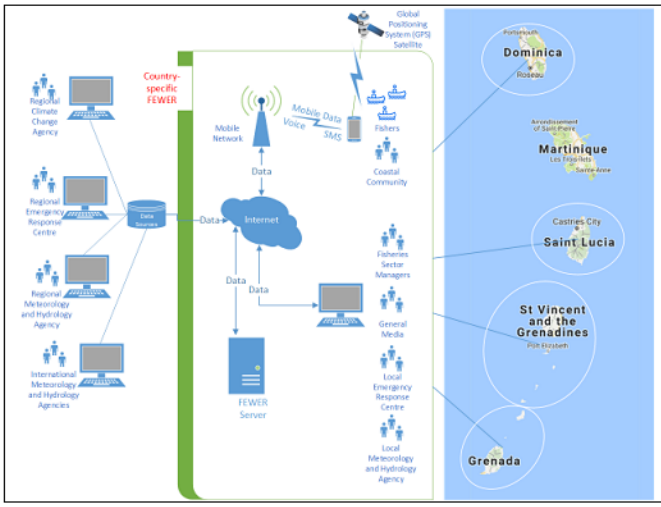
Rough seas, sea surge, high winds, flooding etc. (e.g. from storms, hurricanes)
Other hazards due to any change and variability in climate likely to affect fishers

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

St. George's morning meeting

Grenada project inception and scoping meeting
09:00am – 12:30pm Wednesday 19 April 2017
Fisheries Division conference room, Melville St

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

Grenville afternoon event

Grenville scoping meeting
4:30pm Grenville Wednesday 19 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 fisheries, 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

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 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.
- 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).

[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

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 Capacity

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.

CRFM members are Anguilla, Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago and the Turks and Caicos Islands.

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