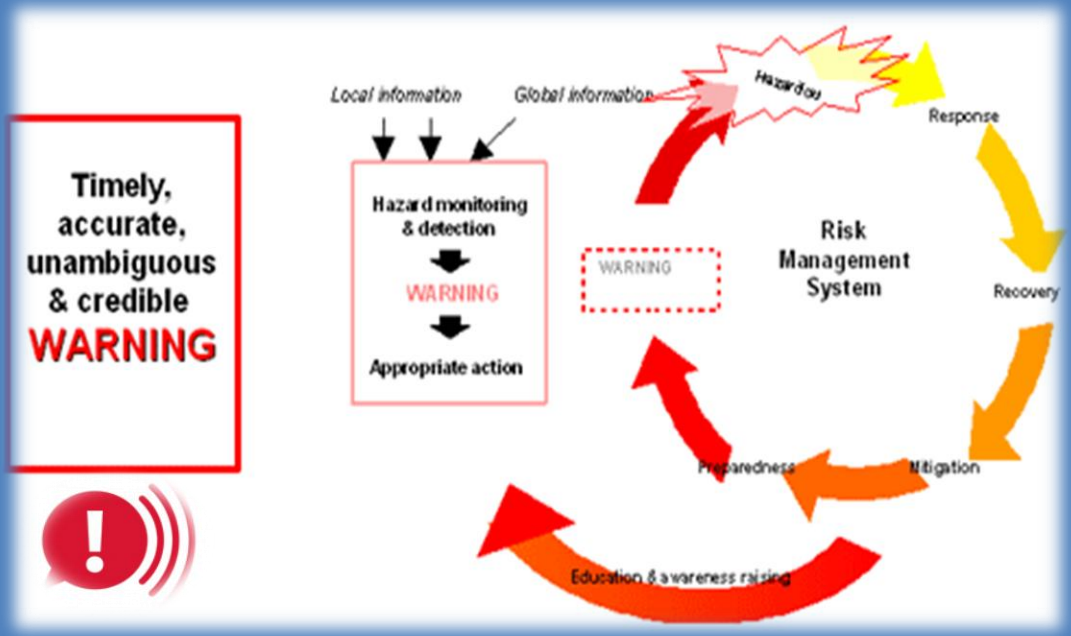
FINAL REPORT

EARLY WARNING SYSTEMS IN THE CARIBBEAN: A DESK REVIEW



Submitted in keeping with the provisions of IFRC Contract # CLM947960

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February 2016

Acknowledgements

I wish to thank the International Federation of Red Cross and Red Crescent Societies and the United Nations Development Programme (Barbados and OECS) for giving me the opportunity to undertake this Desk Review on Caribbean Early Warning Systems which is considered a critical initiative in framing future investments in EWS.

The report would not have been possible without the contributions of Keshra Thomas, CDEMA/IFRC Intern, who assisted in the organizing of the documentation and the developing of the initial EWS inventory.

I would also like to thank the representatives of stakeholder organizations who made themselves available to discuss the perspectives on EWS programming, resourcing and direction. Special mention is made of the efforts of Marlon Clarke from UNDP and Rendal Allen from IFRC who ensured that the Desk Review was initiated and supported.

Jeremy Collymore

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List of Acronyms

ACS	Association of Caribbean States
CADM	Caribbean Disaster Management Project
CAP	Common Alerting Protocols
CARIBE EWS	Caribbean Early Warning System
CARPHA	Caribbean Public Health Agency
CCCES	Caribbean Centre for Climate and Environmental Simulations
CDC	Civil Defence Commission
CDEMA	Caribbean Disaster Emergency Management Agency
CDM	Comprehensive Disaster Management
CEWS	Caribbean Early Warning System
CHAMP	Caribbean Hazard Mitigation Capacity Building Programme
CHC	CDM Coordination and Harmonization Council
CIMH	Caribbean Institute for Meteorology and Hydrology
CMO	Caribbean Meteorological Organisation
CRMI	Caribbean Risk Management Initiative
CTIC	Caribbean Tsunami Information Center
DIPECHO	Disaster Preparedness ECHO programme DRM Disaster Risk Management
DRR	Disaster Risk Reduction
ECHO	European Union Humanitarian Aid
EKACDM	Enhancing Knowledge & Application of Comprehensive Disaster Management

ERC	Enhancing Resilience to Reduce Vulnerability in the Caribbean
EWS	Early Warning System
FAO	Food and Agriculture Organization of the United Nations
FMI	Finnish Meteorological Institute
FUNVISIS	Fundación Venezolana de Investigaciones Sismológicas
GoB	Government of Barbados
GIZ	Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) GmbH
HAZUS MH	Hazards U.S. Multi-Hazard
HYCOS	Hydrological Cycle Observing System
ICT	Information and Communications Technology
IDB	Inter-American Development Bank
IFRC	International Federation of Red Cross and Red Crescent Societies
INETER	Instituto Nicaragüense de Estudios Territoriales
INSMET	Instituto de Meteorología
ICG	Intergovernmental Coordination Group
IOC	Intergovernmental Oceanographic Commission
IPGP	Institut de Physique du Globe de Paris
MER	Monitoring, evaluation and reporting
NDO	National Disaster Office
NGO	Non-governmental organization
NHC	National Hurricane Center
NOAA	National Oceanic and Atmospheric Administration
NTWC	National Tsunami Warning Center
OASIS	Organisation for the Advancement of Structured Information Standards

OCT	Caribbean Overseas Countries and Territories
OECS	Organization of Eastern Caribbean States
PAHO	Pan American Health Organization
PS	Participating State
PTWC	Pacific Tsunami Warning Center
R3I	Regional Risk Reduction Initiative
RA IV	Regional Association IV
REWS	Regional Early Warning System
RRMC	Risk Reduction Management Center
SIDS	Small Island Developing States
SMS	Short Message Service
SOP	Standard Operation Procedures
SRC	Seismic Research Centre
TWFP	Tsunami Warning Focal Point
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISDR	United Nations Office for Disaster Risk Reduction (UNISDR)
UWI	University of the West Indies
VCA	Vulnerability and Capacity Assessment
WB	World Bank
WIGOS	WMO Integrated Global Observing Systems
WSCA	Weather Service Chain Analysis,
WMO	World Meteorological Organization

Early Warning Systems in the Caribbean. A Desk Review

Executive Summary

A. SETTING THE CONTEXT

The recent spate of extreme and catastrophic events in the Caribbean, Tropical Storm Tomas in 2010; 2011 April rains in St Vincent and the Grenadines; December 2013 rains in St Vincent and the Grenadines and Saint Lucia as well as Tropical Storm Erika in Dominica 2015 and rainfall events in Belize and Guyana have re-ignited a dialogue on the adequacy of existing early warning systems (Collymore 2014) and the nature of community engagement in these processes.

These issues underpin the 2015 DIPECHO Caribbean programme, supported through the work of the International Federation of Red Cross and Red Crescent Societies (IFRC) and the United Nations Development Programme (UNDP) for Barbados and OECS, which seeks **"to enhance the enabling environment for community resilience"** and "**strengthening the resilience and coping capacity through integrated early warning systems".** Both of these project interventions target disaster risk management stakeholders and community level operatives in the Caribbean.

Both implementing organisations are undertaking early warning systems (EWS) related activities which include, but are not limited to, the following:

a. Development and application of an EWS training toolkit
b. Development of a Caribbean EWS Case Studies Best Practices Guide
c. Regional Community Early Warning Systems (CEWS) Trainings
d. Harmonization and knowledge sharing of regional EWSs
e. Enhancement of knowledge of risk and vulnerability in communities to improve preparedness and response
f. Integration of CAP-compliant framework for all-hazard early warning systems at the national and community levels

It is envisaged that these proposed interventions will respond to their concerns about the adequacy and robustness of "communication about disasters at the national level and in particular, between national disaster management authorities and communities". Specifically, the interventions seek to address a perceived gap in the comprehensiveness of the existing EWS and the need for these to be all encompassing in audience targeting. Additionally, it is envisaged that the IFRC and UNDP interventions will further integrate and test EWS outputs from their earlier projects, especially the Common Alerting Protocol (CAP). The CAP, which is designed to provide automated notifications of a pending hazard and disseminate warning messages to the population via multiple media simultaneously, will be further developed and tested for integration into national EWS.
Community Early Warning Systems training, is proposed in collaboration with regional and national stakeholders. It will be based on the IFRC "The Community Early Warning Systems: Guiding Principles" a resource that was informed by learning from successful global EWS practice at diverse levels.

IFRC and UNDP recognize that prior work in EWS in the Caribbean has been undertaken in the last fifteen years and wish that their interventions be informed by the good practices, lessons identified and opportunities raised. It is against this background that the Desk Review of the EWS in the Caribbean is undertaken.

A key consideration in informing the schedule in the assignment was the desire to share the results in the Comprehensive Disaster Management Conference, held November to 4 December, 2015 in The Bahamas. Given the challenges in finalization of the assignment arrangements an accommodation was made for a launch of the Desk Review instead.

A.1 Context of the Project

This consultancy is part of a DIPECHO Caribbean Project that seeks to inform the enhancement of EWS in the Caribbean through the:

a. Identification, documenting and sharing of EWS good practice case studies.
b. Testing and integration of CAP
c. Review and adoption of EWS Toolkits

A.2 Methodology

The content of this Report is based on information collected through a systematic review of the available documents relevant to EWS in the Caribbean, as well as from web research and targeted stakeholder semi-structured interviews. More than a hundred documents were consulted. The number of stakeholder consultations was influenced by the relatively limited resources for the review.

The methodology included a literature review of relevant documents, web-searches and semi-structured interviews. This approach was driven by the Consultant's belief in the value of the diversity and representativeness of the data sources and the validation of the information generated therefrom. The list of documents consulted is attached as Appendix I and a listing of the stakeholders interviewed is attached at Appendix II.

A.3 Limitations of the Study

The information sources were targeted to the actors who are known to be actively involved in the design and implementation of EWS programs and projects in the primarily the English speaking Caribbean. It is recognized that there are other actors whose work may contribute to EWS goals but may not be so explicitly identified e.g. the FAO, WB, IADB and UNESCO. This issue of explicit articulation also applied to the targeted stakeholders whose EWS initiatives are sometimes reflected as outputs or activities of larger projects and may not be reflected in the review.

In many cases the specific monetary values of project or other initiatives were not available in the documentation accessed. As a result, the total values of EWS investments suggested may be understated. Document retrieval was also a constraint. Whereas the stakeholder organization is aware of prior EWS initiatives there were sometimes challenges in retrieving the relevant documentation. Notwithstanding, the information provided in this Report is believed to fairly represent a profile of the EWS initiatives in the English speaking Caribbean over the last 15 years.

A.4 Early Warning Systems: Principles and Elements

Amidst today's conflict ridden world, reducing the human, economic and environmental losses from natural disasters remains one of our key collective challenges. Economic and social development, and the escape from poverty, cannot be successful without addressing the problem of disasters (Jan Egeland 2003). Egeland's observation that the devastating impact of natural hazards and to some extent man-made phenomena can be significantly reduced with effective planning and the provision of timely warning for disaster officials, emergency responders and communities in general underpins the Regional Strategy for Comprehensive Disaster Management (CDM).

Early warning systems require multi-disciplinary risk knowledge, understanding and hazard mapping that can produce and disseminate understandable warnings which are driven by monitoring and forecasting impending events of the hazards to political authorities and the population allowing them to undertake appropriate and timely actions in response to the warnings. These systems build on existing discipline-based research in the geophysical and environmental fields. Having the risk knowledge and the ability to produce the forecasts and warnings is not enough. Effective warning systems must be supported by the political, economic and social elements.

Based on several case studies, GIZ concluded that effective early warning is possible in Latin America under three conditions. First, the countries of the region need specific international assistance, especially concerning forecast, technology, advice and training. Second, early warning systems have to take into account and be adapted to national circumstances in order to achieve sustainability and cost-benefit efficiency, and the underlying structural deficiencies such as poverty, centralism and high staff turnover, can only be influenced through the long-term development process. Third, early warning cannot take the place of comprehensive disaster risk management, but must be seen rather as part of such an approach. The observations, by Wolfgang Stiebens and Christina Bollin, cited in the Executive Summary of the UNISDR 2003 **Early Warning as a Matter of Policy: The Conclusions of the Second International Conference on Early Warning**, do reflect the Caribbean challenge.

The Bonn EWS Conference represented the watershed in the global discourse on policy and practice on EWS. It endorsed the principles of EWS earlier shared by the UNISDR (1997] and recognized that the objective of early warning is to empower individuals and communities, threatened by natural or similar hazards, to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life and damage to property or nearby and fragile environments.
It generated, and continues to generate, much discussion on early warning systems and what they entail. The Caribbean did not escape this search for engagement. Moreover, the Sendai Framework for 2015-30, has set clear targets for EWS. This is to, "**Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030 through adequate and sustainable support…**" This will require an even more robust engagement and cooperation among all stakeholders.

This message of collective responsibility and people centred humanitarian and development action is permeating many global processes in which the Caribbean is engaged, including the process leading up to the World Humanitarian Summit (WHS). It embraces the key action areas of promoting safety, dignity and resilience (WHS 2016).

B. EVOLUTION OF EWS IN THE CARIBBEAN

B.1 Early Warning Systems in the Caribbean: 2000-2015

Concerns about the timeliness, adequacy and effectiveness of early warning systems in the Caribbean have been longstanding (Collymore 1989; 2004; 2014; Villagran de Leon et al 2003). Whilst these issues were consistently noted there was no comprehensive regional framework for assessing the status of EWS in the region until 2003. The Report on EWS in the Caribbean undertaken as part of sub-regional preparation for the Global Second Early Conference in Bonn embraced the emerging principles and components of EWS (Villagran et al 2003). A consultation on the results of this study and others in Latin America was characterized as the first event of its kind in the American Hemisphere. Focusing on the context, current status and future trends it presents a platform for looking at the early warning initiatives in the Caribbean over the last decade and a half.

The Americas Hemispheric EWS Consultation established an articulation for early warning system as "a process which involves three types of actors: 1. **scientific and technical institutions**, which are in charge of studying and monitoring natural events to provide models which can be used to forecast events in terms of intensity, time, and geographical span. 2. **Authorities and Civil Protection Agencies**, which are in charge of establishing operations frameworks related to preparedness and response in case of events. 3. **Communities**, which must understand the nature of the hazards, their possible intensities and ranges, and react according to preset guidelines provided by the civil defense institutions in conjunction with authorities (Villagran et al 2003). It should be noted that although the articulation may vary, these are the three elements that represent the basic tenets of an effective early warning system as articulated by the EWC II.

There was general recognition that early warning systems were established for the more frequently experienced hazards (floods and hurricanes) and the information and communication technologies were being introduced into the EWS process.

The study acknowledged the embryonic work in the development of tsunamis, volcano and forest fires and explored the constraints for the limited efforts in EWS for other types of phenomena such as landslides, earthquakes, climate change, and El Niño. It concluded that in the majority of these cases, the main problem was related to the poor understanding of the phenomena, which did not allow for precise forecasting and the lack of adequate resources to implement the and operate the systems (Villagran et al 2003).

Another key observation emanating from the Villagran et al 2003 study was the lack of public policies specifically dedicated to early warning. The significance of this finding was mitigated by the consensus that there are disaster reduction public policies which encompass early warning.

This is the backdrop against which the EWS initiatives and studies in the Caribbean are reviewed.

In presenting an overview of EWS initiatives in the Caribbean in the last 15 years there is an opportunity to reflect on the diversity of hazards for which EWS have been elaborated, the use of ICT, the diversity and scope in the EWS components considered. It also presents the space for exploring how far we have moved in EWS since the Valliagran et al study in 2003.

B.2 The evolution

Within the last 15 years, the development and application of scientific knowledge has led to the enhancement of the different types of early warning systems (pre-science, ad-hoc science, systematic end-to-end) that are used within the Caribbean region. Since 2000, there have been at least 3 major studies to assess EWS in the Caribbean. These include the 2003 Caribbean EWS Study (Villagran et al 2003; CADM 2006 EWS Survey; WMO 2011).

In addition, there has been a diversity of regional and national level EWS interventions, covering all dimensions of EWS. At least 75 per cent of these have sought to address more than two components of EWS, or more than one dimension of the EWS triangle (figure 2). Our data suggest that the majority of the interventions focused on the warning tool, equipment and capacity building components of the early warning system.

The review also suggested that post 2003 there appeared to be a significant investment in EWS. It is estimated that more than US 50 million dollars were invested in early warning systems by partners since 2003 touching all components of the EWS Triangle.

At the national and regional levels, the move towards developing people-centred approaches may be attributed to the increased awareness generated by the discussion of the results of the Study in the region and the global championing of this cause resulting from the declaration and policy guidance emanating from the 2nd Early Warning Conference in Bonn, also in 2003. According to UNISDR, a complete and effective people centred approach to EWS "empowers individuals and communities threatened by hazards to act in sufficient time in an appropriate manner to reduce the possibility of personal injury, loss of life and damage to property and the environment. It has four inter-related elements an illustrated in Figure 1, encompassing knowledge of hazard and vulnerabilities to preparedness and response capacity.

The EWS triangle (figure 2) looks at the governance mechanism recommended for EWS and should not be used as a replacement of the four components of a successful EWS mentioned in figure 1. The triangle looks at national to local emergency planning and related linkages to EWS and involves the development of policies, institutional and level frameworks to support emergency planning. It is therefore recognized that an effective integrated EWS will engage actors on all three sides of the Triangle within the four components.

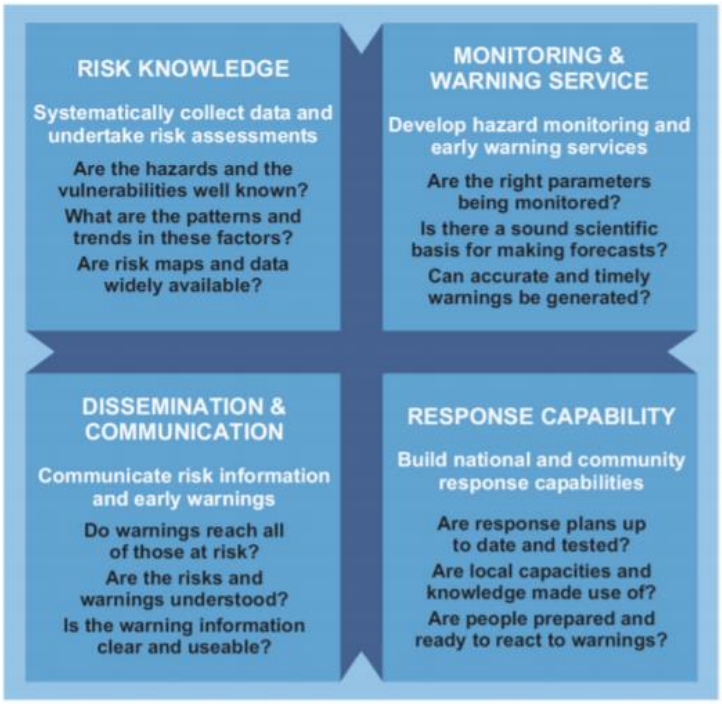

Figure 1: Four Elements of People-centred Early Warning Systems

Source: UN/ISDR Platform for the Promotion of Early Warning

It must be noted that this people-centred approach was not used as the main EWS reference, but the EWS Triangle mentioned previously. The report presents this triangle as a conceptual platform for recognizing the core ingredients of integrated EWS.

It is also noted that since 2005 the objectives of Early Warning Systems initiatives in the Caribbean were articulated within the context of resilience, disaster risk management or other such expression that made a link to development. The association between this observation and the birth of the Comprehensive Disaster Management Strategy in the region and the global Hyogo Framework for Action is worth further consideration.

The salient message is that ***the convergence of regional and international agendas can be rewarded with increased financial and capacity building support for the vulnerable states of the Caribbean.*** Growth and diversity in the number of EWS sponsoring entities and project collaborators was also noted as is the gap of a facility to harness these common interests.

B.3 Hazard specific Early Warning Systems

The Caribbean region benefits from a well–developed warning and forecasting system for hurricanes that is supported by a network of Doppler radars and satellite imagery strategically place throughout the region in Barbados, Belize, Guyana, Trinidad, French Guiana, Martinique, Guadeloupe, Dominican Republic and Jamaica (Villagran et al 2003; CADM 2006; WMO 20110).

Drought forecasting is emerging with the work being done by Cuba and the Caribbean Institute of Meteorology and Hydrology (CIMH) through the quarterly precipitation outlooks for the region (Farrell 2016; Trotman 2010).

The Seismic Research Centre (SRC) of The University of the West Indies monitors earthquakes and volcanoes for the English-speaking islands of the Eastern Caribbean and also manages the Montserrat Volcano Observatory in collaboration with the Institut de Physique du Globe de Paris (IPGP). In addition to SRC's instrumentation, seismographs networks are strategically located throughout Cuba, Jamaica, the Virgin Islands and the Cayman Islands (SRC 2016).
Efforts are also on the way to address Tsunamis early warning and pandemic threats.

There is general consensus on the need for multi-hazard EWS and discussions have been initiated by various stakeholders, including the CIMH, SRC, UNDP, IFRC, JICA, USAID, UWI CDEMA, on how this should be operationalized.

B.4 Geospatial framework of the EWS interventions

Decision support systems which are used for early warning that rely on geospatial information have increased over the 15 years of the Desk Review (DR) and are increasingly being embedded in the operations of regional governments and technical institutions (Farrell 2014; Taylor et al 2014; Opadeyi 2014; CADM 2008).

The 2009 CDEMA commissioned research on the application of Geographic Information Systems (GIS) for Disaster Early Warning Systems noted that although the Caribbean is vulnerable to a number of natural, technological, biological hazards and social hazards the early warning infrastructure, outside of what is used for cyclonic events, is generally unstructured. This supports the observations of the Villagran et al 2003; CADM 2006 and WMO 2011; SHOCs 1 2014.

B.5 Hazard research and understanding: Downscaling from hazard modeling to contingency planning

Forecasting is an essential part of flood early warning systems; the link between data collection and issuing a warning and highlights the importance of accurate and timely data and modeling (See CIMH 2016, SRC 20, Taylor et al 2014. The CADM project implemented by CDEMA, with support from JICA, demonstrated tangibly how the mix of hydrologic science, community knowledge and social science contributions can result in locally owned flood maps and the use of these to inform flood contingency planning in Speightstown, Barbados, Mesopotamia in St. Vincent and the Grenadines and Capro River in Trinidad and Tobago (CADM 2012; Opadeyi 2004; Spence et al 2004.)

What one sees emerging in the Caribbean are the elements of an integrated early warning architecture: the linkages and interactions among all the elements necessary to effect early warning and response that include the role of the human elements of the system and the management of risks rather than just warning of hazards and a move away from the organized, linear and largely unidirectional delivery by experts of warning products to users (Basher 2006). This is characterized by the WMO (2011) as the multi-hazard approach.

Such a development requires the careful husbandry of the process and people dynamics. A Caribbean Early Warning Alliance may provide the technical and governance architecture for managing these.

Efforts have been made in several Caribbean countries through projects, like the (a) Caribbean Disaster Management Project, (b) Caribbean Risk Management Initiative Phases I and II, (c) Caribbean Overseas Countries and Territories Regional Risk Reduction Initiative, (d) Caribbean Hazard Mitigation Capacity Building Programme and the (e) Enhancing Resilience to Reduce Vulnerability in the Caribbean project, to enhance hazard understanding and the importance of public participation in increasing the effectiveness of disaster risk reduction strategies. Government buy-in and sector engagement has evolved over the years.

However, the divide between scientific research, risk legislation and risk management though diminishing still exists. Efforts to involve at-risk populations in the development of the early warning systems are also improving.

B.6 National EWS Policy

The purpose of EWS policies is to establish authority for system administration, control, access, maintenance and use of disaster alert, notification and warning systems. CDEMA Audits (2010) suggests that 71 % of its PS indicate the existence of an early warning Policy. The observation of the 2003 Caribbean EWS Study that often specific EWS Policy may not exist but policy guidance may be deduced from other DRM related instruments may be appropriate here. The observations, by Basher 2006, that in order to measure benefits and performance of EWS we must also develop a systems culture that sets and achieves well-defined performance objectives and standards for each system are relevant here. We did not encounter evidence of this.

Consequently, it was challenging to respond to, one of the specific questions of the study as to "What examples exist of seamless integration of national and community early warning systems?"

B.7 Early Warning In National and Regional Work Programmes

An effort was made to examine if and how EWS is articulated in the planning frameworks or work programs of the regional and multi-lateral organizations identified as key stakeholders in the study. The intent was to see how high in the strategic intervention chain is EWS anchored, if it is specifically expressed at all. Strategic placement is seen as a proxy indicator of how stakeholder organizations are preparing themselves to lead or contribute to the emerging transition in the Caribbean from systematic end to end to integrated warning systems.

At the national level the CDEMA summary of work programs of its Participating States (PS) and its DRM Audits were reviewed to see the country level efforts in EWS (Cooke 2011; Mahon 2014). This was intended to suggest EWs demand and scope. A constraint in this direction of analysis was the inconsistency of the PS submissions over time. ***At both the national and regional level programming EWS contributions were usually wrapped up in other DRM initiatives and distilled at the level of EWS component outputs.***

C. CONCLUSIONS AND RECOMMENDATIONS

C.1 Conclusion based on scoping questions

With respect to the three focus questions of the study we were able to observe following:

Definition of a successful Early Warning System (EWS) - We indicated our support for the principles and components of an early warning system as adopted at the Second International Conference on Early Warning and reflected in the recommendations of the 2003 Hemispheric Consultation in the Americas. In this context, a successful EWS has to meet several requirements including the use of appropriate technology and know-how, clear responsibility of the parties, effective decision making support mechanisms, functioning communications systems and supporting preparedness instruments including evacuation planning and response structures. Additionally, in terms of its effectiveness, we will need to consider the adequacy and timing of the messages and information disseminated as well as the public's confidence in the process.

In the Caribbean whilst we have made significant advances in EWS especially for cyclonic events, there is still much work to be done to meet these essential elements of a successful early warning system.

*Examples of seamless integration of national and community early warning systems - W*hilst there have been many initiatives at national EWS enhancement and community disaster preparedness for the most part these have not focus on interfacing or where considered have essentially been pursued at the community level. We believe that Cuba through the Risk Reduction Management Center (RRMC) initiative provides an effective model which demonstrates how the process of national frameworks and community disaster preparedness interfacing can be operationalized. It's exportation to the Caribbean is an important contribution in framing how we proceed on this level of integration.

Reduction in damage or loss of live in the community or country attributed to the establishment of early warning systems. Collymore 2005, in a study on EWS in the Caribbean, highlighted the strong association between the improvement in EWS for hurricanes and the significant reduction in loss of life over a 40-year period. This was generally so for the English speaking Caribbean and Cuba. It was noted however that in Haiti and the Dominican Republic, where hurricane warning systems at that time were not so deeply elaborated, there was sustained loss of life. The real question is how does one relate this to other benefits beyond mortality reduction? It raises the issue of cost benefit analysis, reinforces the call for more research on cost and benefits of early warning interventions and especially for value change analysis of EWS. Above all, there is need to have clear standards for performance and indicators of measurement of effective EWS. This also reinforces the key consideration made in our study for both the improvement of standards of and better performance monitoring for EWS.

C.2 Recommendations

The Desk Review of EWS in the Caribbean has presented a picture of some progress in advancing early warning in the region whilst at the same time suggesting a need to accelerate the enhancement process. The rapidly changing nature of hazards, society and technology calls for an overhaul of the mindset if the enhancement interventions are to impacting and sustainable.

Over the last 15 years there has been observed improvements in early warning systems though this has been variable both by hazard and in space. Movement towards an integrated multi-hazard warning systems culture is evident though this may be characterized as slow. The existing resource deficits, human and fiscal, will dictate the paste at which the region transitions from the dominant techno-scientific warning system architecture to one that embraces all EWS stakeholders. The desire for an inclusive EWS culture in an environment of scarce resources will forge a necessary discussion of the costs and benefits of early warning investments, value chain analysis and prioritization.

To accelerate the advancement of people-centered early warning systems calls for a reset of the mindset that now drives DRM and EWS policy and practice in the Caribbean. It will require a revisit of the placement of EWS in the strategic and operational plans of stakeholders at all levels, the embracing of monitoring and evaluation frameworks and standards for measuring performance.

Additionally, there is a need to examine how EWS capacity needs are reflected in the DRM knowledge management programmes of the region and the required research and product development to support this. The actors in EWS in the Caribbean are many and their programmes and places of operations equally diverse.

There is an urgent need for a facility to harmonize these efforts and share a common Early Warning Vision for the Caribbean. It appears that this is the opportune moment for a **Caribbean Early Warning Alliance.** The recommendations below are intended to offer ingredients for the change in mindset and the move towards a Caribbean EWS Alliance.

C.2.1 Address Gaps in Early Warning Communications

Recent assessments of existing early warning systems show that in most cases communication systems and adequate response plans are missing. Even where EWS protocols may have been elaborated there are many instances of limited familiarity with and/or conflicting legislative or regulatory instruments that compromise effective operationalization. Action is required to:

i. Review the provisions of existing legislation for alert and warning
ii. Promote documentation and dissemination of approved protocols
iii. Formalize mechanisms for scheduled testing and public education and awareness of the protocols
iv. Establish a Regional Review Programme of early communications
v. Establish a standard for post impact early warning performance assessment
vi. Assess the CAP as a contributor to the enhancement of the early warning communications

C.2.2 Accelerate Efforts to engage all Stakeholders in the EWS Triangle

This is necessary if more progress is to be made towards the enhanced use of hazard information products for practical applications in terms of hazard analysis, preparedness and response planning. The initiation of EWS interventions in the Caribbean as ex post impact opportunities, observed in 2003, appears to be still a reality and may account for some of the omissions of obvious stakeholders, institutions and states from their design and implementation. The following are suggested:

i. Advance the promotion of the articulation of the scientific and technical process of data acquisition, hazard modelling and forecasting with local resilience building actions.
ii. Interpret and translate scientific information into practical formats for the general population, institutions and public education needs.
iii. Accelerate the involvement of stakeholders from the non-scientific community early in the development of EWS interventions and the redesign of existing ones.

C.2.3 Establish a Strategic Vision for EWS development

i. Establish a Stakeholder Working Group to draft recommendations for A Caribbean EWS Strategic Vision for EWS, anchored in the global EWS Principles.
ii. Promote dialogue among stakeholder constituents
iii. Present a EWS Strategic Vision to the CDM Harmonization Council (CHC) for endorsement
iv. Lobby for adoption of the EWS Strategic Vision within a Regional Political Forum

C.2.4 Revisit and Strengthen the Governance Framework of EWS

Consensus on a EWS program in the Caribbean is a key requirement for structured cooperation and collaboration especially where there is a desire to see EWS treated as a subsystem embedded and integrated into larger socioeconomic and political systems. There is an opportunity for CDEMA and CIMH to partner with other regional organizations, development partners and civil society actors to accelerate the cooperation architecture for fuller exploration of synergies. This gap was recognized by these institutions and other stakeholders during the stakeholder dialogues and was strongly encouraged. The following may be considered:

i. Build on the CIMH Stakeholder Facility to establish a broader Stakeholders Forum. Integration of this into the CDM Harmonization Council (CHC) governance process should be considered.
ii. Establish EWS standards for data management, product development and performance assessment.
iii. Establish protocols for harmonized EWS program development
iv. Agree on lead roles and responsibilities of stakeholders.

C.2.5 Prioritize EWS Investments

Because of limited resources (human and financial) in many countries, it is important to distinguish between what is desirable for an effective EWS and what is essential. This speaks to the need for an upfront discussion on priorities, roles and resource requirements and realistic time frames. Roles and responsibilities complementarities among stakeholders are crucial as no single entity can effectively address all the needs. The synergies between stakeholder programs and projects require more dialogue, coordination and cooperation. This is especially required as the region appears to be moving towards an integrated EWS process. It is recommended that:

i. Research be undertaken on the cost benefits of existing EWS

ii. EWS investments be informed by the considerations of scheduled audits, results of MER frameworks and by priorities agreed within the EWS Stakeholder Alliance.

C.2.6 Work towards the Consolidation of National Integrated Multi-hazard EWS

There is evidence of many EWS interventions at the community level that are not, or are poorly, synched with the national EWS architecture. Key actions steps required include

i. Considering and adopting/adapting the EWS principles and policy guides agreed at Bonn 2003.
ii. Reviewing the IFRC Community Early Warning System Toolkit for adaptation in the Caribbean. The steps towards this are suggested as:
    a. Establishment of a CEWS Training Working Group, within the Civil Society Committee of the CDM Harmonization Council, whose task would be to lead the mapping of existing products, actors and communities early warning systems.
    b. Creation of an inventory, or plug into existing ones, and determine the training depth needed to support such a program
    c. Development, or adaptation, of Principles to inform EWS in the Caribbean. The IFRC has elaborated a model which can be considered.

d. Formulation of a strategy for integrating the CEWS within the CDM Knowledge Management infrastructure.

C.2.7 *Make EWS more visible in National and Regional Strategies and Programs*

i. Making EWS results more explicit in work and strategic plans of all stakeholders
ii. Agree on a suite of indicators to be considered for measuring EWS performance
iii. Adopt standards for measuring early warning systems performance
iv. Establish a EWS Case Study Program that can facilitate sharing of good practices and expertize.

D. CONNECTING GLOBALLY

The Desk Review suggests that the traction in EWS in the Caribbean is closely bound to the guidance and principles emerging from global discourse actioned through regional collaborating mechanisms and institutions. The Sendai Framework 2015-2030 and the Secretary General's Report to the General Assembly on the World Humanitarian Summit (WHS) 2016 provide the space for political action, stakeholder collaboration around the kernels of dignity, safety and resilience**.**

The issues identified and the recommendations offered present an opportunity to connect our future investments in EWS to the targets and core principles of these processes. They can assist in framing our blueprint for engagement at local, national, regional and international levels.

Setting the Context

Section 1: Setting the Context

1.0 INTRODUCTION AND PURPOSE OF THE STUDY

The recent spate of extreme and catastrophic events in the Caribbean, Tropical Storm Tomas in 2010; 2011 April rains in St Vincent and the Grenadines; December 2013 rains in St Vincent and the Grenadines and Saint Lucia as well as Tropical Storm Erika in Dominica 2015 and rainfall events in Belize and Guyana have re-ignited a dialogue on the adequacy of existing early warning systems (Collymore 2014) and the nature of community engagement in these processes.

These issues underpin the 2015 DIPECHO Caribbean programme supported through the work of the International Federation of Red Cross and Red Crescent Societies (IFRCS) and the United Nations Development Programme (UNDP) for Barbados and OECS which seek **"to enhance the enabling environment for community resilience"** and "**strengthening the resilience and coping capacity through integrated early warning systems".** Both of these project interventions target disaster risk management stakeholders and community level operatives in the Caribbean.

Both implementing organisations are undertaking early warning systems (EWS) related activities which include, but are not limited to, the following:

i. Development and application of an EWS training toolkit
ii. Development of a Caribbean EWS Case Studies Best Practices Guide
iii. Regional Community Early Warning Systems (CEWS) Trainings
iv. Harmonization and knowledge sharing of regional EWSs
v. Enhancement of knowledge of risk and vulnerability in communities to improve preparedness and response
vi. Integration of CAP-compliant framework for all-hazard early warning systems at the national and community levels

It is envisaged that these proposed interventions will respond to their concerns about the adequacy and robustness of "communication about disasters at the national level and in particular, between national disaster management authorities and communities". Specifically, the interventions seek to address a perceived gap in the comprehensiveness of the existing EWS and the need for these to be all encompassing in audience targeting. Additionally, it is envisaged that the IFRC and UNDP interventions will further integrate and test EWS outputs from their earlier projects, especially the Common Alerting Protocol (CAP).

The CAP, which is designed to provide automated notifications of a pending hazard and disseminate warning messages to the population via multiple media simultaneously, will be further developed and tested for integration into national EWS.

Community Early Warning Systems training, is proposed in collaboration with regional and national stakeholders. It will be based on the IFRC 'The Community Early Warning Systems: Guiding Principles' a resource that was informed by learning from successful global EWS practice at diverse levels.

IFRC and UNDP recognize that prior work in EWS in the Caribbean has been undertaken in the last fifteen years and wish that their interventions be informed by the good practices, lessons identified and opportunities raised. It is against this background that the Desk Review of EWS in the Caribbean is being undertaken. A key consideration in informing the schedule in the assignment was the desire to share the results in the 9th Comprehensive Disaster Management Conference held in December 2015 in The Bahamas. Given the challenges in finalization of the assignment arrangements an accommodation was made for a launch of the Desk Review instead.

1.1 *Context of the Project*

This Desk Review is part of a DIPECHO Caribbean Project that seeks to inform the enhancement of EWS in the Caribbean through the:

a. Identification, documenting and sharing of EWS good practice case studies
b. Testing and integration of CAP
c. Review and adoption of EWS Toolkits

1.2 Methodology

The Consultant recognized the explicit need for IFRC and UNDP projects to be informed by lessons learnt from prior EWS in the Caribbean and other small island developing states; engagement of the diverse stakeholders in DRM, and EWS in particular, and to harvest and build from the good practices and opportunities generated from such processes and initiatives.

The methodology included a literature review of relevant documents, web-searches and semi-structured interviews. The content of this desk review is based on information collected through a systematic review of the available documents relevant to EWS in the Caribbean, as well as from web research and targeted stakeholder semi-structured interviews.

1.2.1 *Document Review*

The Consultant undertook a desk review of selected background documents related to EWS in the Caribbean in particular. These included those shared by the key EWS actors identified in the project document, and others, and at least include CDEMA, CIMH, SRC, UNDP, IFRC, CARPHA, PAHO and some NDOs. Additionally, strategy and programming documents that speak to resilience, such as the 2014-2024 CDM Strategy and partner aligned documents were considered. This was supplemented by web searches.

A preliminary list of documents was shared with the Implementation Plan and an updated listing which was expanded during the stakeholder consultation and document sourcing activities is attached as Appendix I. More than 100 items were consulted inclusive of EWS assessments, project reports, research and presentations.

Whilst the Consultant was invited to consider documentation of EWS in the French and Dutch departments/territories there was not much literature accessible in English to realize this.

Donor-specific documents that speak to their development assistance vision, annual reports of the beneficiary states and local implementation partners, as well as reports on the implementation of the Comprehensive Disaster Management programme were also reviewed, where available. This additional documentation allowed for assessing the link between awareness, strategies and commitment to action.

1.2.2 *Semi-structured interviews*

In keeping with the commitment of diversity and representativeness in the study semi-interviews were sought with selected officials/representatives from the following project and beneficiary entities:

a. Project Implementation and Execution Agencies [UNDP and IFRCS]
b. Technical Collaborating Institutions and Agencies [CDEMA Coordinating Unit, CIMH, SRC, PAHO, CARPHA,]
c. Four CDEMA Participating States were engaged for the stakeholder dialogue, Barbados, Virgin Islands (British), Saint Lucia and Jamaica.

Limited follow-up interviews were conducted to facilitate cross-referencing and the validation of findings.

1.2.3 *Limitations of the Study*

The information sources were targeted to the actors who are known to be actively involved in the design and implementation of EWS programs and projects in the primarily the English speaking Caribbean.

It is recognized that there are other actors whose work may contribute to EWS goals but may not be so explicitly identified e.g. the WB, IDB, FAO and UNESCO. This issue of explicit articulation also applied to the targeted stakeholders whose EWS initiatives are sometimes expressed as outputs or activities of larger projects and may not be reflected in the review.

In many cases the specific monetary values of projects or other initiatives were not available in the documentation accessed. As a result, the total values of EWS investments suggested may be understated.

Document retrieval was also a constraint.

Document retrieval was also a constraint. Whereas the stakeholder organization is aware of prior EWS initiatives there were sometimes challenges in retrieving these for the review.

Notwithstanding, the information provided in this Report is believed to represent a profile of the EWS initiatives in the English speaking Caribbean over the last 15 years.

2.0 EARLY WARNING SYSTEMS: PRINCIPLES AND ELEMENTS

Amidst today's conflict ridden world, reducing the human, economic and environmental losses from natural disasters remains one of our key collective challenges. Economic and social development, and the escape from poverty, cannot be successful without addressing the problem of disasters (Jan Egeland 2003). We share Egeland's observation that the devastating impact of natural hazards and to some extent man-made phenomena can be significantly reduced with effective planning and the provision of timely warning for disaster officials, emergency responders and communities in general.

Garcia (2012) cautioned that early warning systems should not be seen as "simple linear mechanisms" that are used to alert the population about an impending phenomenon of such severity.

Early warning systems require multi-disciplinary risk knowledge, understanding and hazard mapping that can produce and disseminate understandable warnings which are driven by monitoring and forecasting impending events of the hazards to political authorities and the population allowing them to undertake appropriate and timely actions in response to the warnings (Garcia 2012) {See figure 1}. These systems build on existing discipline-based research in the geophysical and environmental fields. Having the risk knowledge and the ability to produce the forecasts and warnings is not enough. Effective warning systems must be supported by the political, economic and social elements. Mitigation and contingency plans based on comprehensive risk assessments, underpinned by geo-spatial data and geographic information systems are fundamental to reducing the debilitating effects of emergencies and disasters.

Having the risk knowledge and the ability to produce the forecasts and warnings is not enough.

Early warning systems have to meet several requirements, including the use of appropriate technology and know-how, clear responsibilities of parties and effective decision taking mechanisms, a functioning communication system and well-prepared evacuation and response structures. Unfortunately, these conditions are often missing in developing countries, including those in the Caribbean, owing to financial, technical and organizational deficiencies (Trotman et al 2010; Lombroso et al 2014).

Based on several case studies, GIZ concluded that effective early warning is possible in Latin America under three conditions. First, the countries of the region need specific international assistance, especially concerning forecast, technology, advice and training. Second, early warning systems have to take into account and be adapted to national circumstances in order to achieve sustainability and cost-benefit efficiency, and the underlying structural deficiencies such as poverty, centralism and high staff turnover, can only be influenced through the long-term development process. Third, early warning cannot take the place of comprehensive disaster risk management, but must be seen rather as part of such an approach.

The observations, by Wolfgang Stiebens and Christina Bollin, cited in the Executive Summary of the **UNISDR 2003 Early Warning as a Matter of Policy: The Conclusions of the Second International Conference on Early Warning** reflect the EWS context of the Caribbean. This Bonn EWS Conference represented the watershed in the global discourse, policy and practice on EWS.

It endorsed the principles of EWS earlier shared by the UNISDR (1997] and recognized that the objective of early warning is to empower individuals and communities, threatened by natural or similar hazards, to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life and damage to property, or nearby and fragile environments.

It generated, and continues to generate, much discussion on early warning systems and what they entail. The proposition that the most common current view of early warning systems comprises a 'warning chain', a linear set of connections from observations through warning generation and transmittal to users is generally accepted (Glanz 2004; EWC11 3003; Basher 2006; UNISDR 2009).

To be effective, early warning systems for natural hazards need to have not only a sound scientific and technical basis, but also a strong focus on the people exposed to risk, and with a systems approach that incorporates all of the relevant factors in that risk, whether arising from the natural hazards or social vulnerabilities, and from short-term or long-term processes (Basher 2006).

At the heart of all early warning systems is some sort of model that describes the relevant features of the hazard phenomenon and its impacts, particularly their time evolution. The model provides the means to make projections of what might happen in the future—and therefore what actions might be desirable in response (Basher 2006). The nature of models can vary widely from basic traditional awareness to global probabilistic and across timescales.

Figure 2: EWS triangle (Vallagran et al. 2003)

Basher 2006 also recognizes that other models also underlie the other parts of the warning system, such as the likely impacts of a hazard, the way warnings are communicated and acted on, and the dynamics of evacuation processes, but these vulnerability and response process models are generally much less developed than the geophysical process models.

The dominance of the geo-physical models is associated with the techno-scientific dominance side of the EWS triangle, Figure 2. The scientists are usually seen to be the custodians of the geophysical and technical knowledge base upon which the warning system relies. As a result, early warning systems have tended to be largely conceived as hazard-focused, linear, top-down, expert driven systems, with little or no engagement of end-users or their representatives (Basher 2006).

Whilst there is recognition of this short coming there is the also the reality of people's indifference to EWS except in conditions of direct threat. This has not daunted efforts to improve the Early Warning Systems to allow for more involvement of those critical actors. Rather it is really the core of the Integrated Multi-Hazard Early Warning Systems approach. This concept, as proposed by Basher, promotes the linkages and interactions among all the elements necessary to effect early warning and response, the role of the human elements of the system and the management of risks rather than just warning of hazards.

The expansion of the actors and the interactions among them, with an Integrated Multi-hazard EWS framework, creates demand for administrative, technical and competency resources that are generally in short supply in the region.

Because of limited resources (human and financial) in many countries, it is important to distinguish between what is desirable for an effective EWS and what is essential (Glanz 2004; Lombroso 2014).

The apparent contradiction between integration and resourcing has introduced discussions on EWS cost and benefits and prioritization.

The apparent contradiction between integration and resourcing has introduced discussions on EWS cost and benefits and prioritization. In a revenue starved environment the issues of cost recovery and income generation are beginning to emerge. This is especially pronounced for hydro-meteorological services. In weighing on this issue in the Caribbean, Perrill (2012) posited that adequate warnings have high benefit cost ratios but cautions that further development of warning services stretches out over all segments of the service chain and calls for the introduction of weather chain analysis as part of a process of better assessing the value points of the EWS.

The above expression of the principle and components of EWS are used to inform our analysis of the EWS initiatives identified in this Desk Review.

Evolution of EWS in the Caribbean

Section 2: Evolution of EWS in the Caribbean

3.0 EARLY WARNING SYSTEMS IN THE CARIBBEAN: 2000-2015

3.1 The Context

Concerns about the timeliness, adequacy and effectiveness of early warning systems in the Caribbean have been longstanding (Collymore 1989; 2005; 2014; Villagran de Leon et al 2003). Whilst these issues were consistently noted there was no comprehensive regional framework for assessing the status of EWS in the region until 2003. The Report on EWS in the Caribbean undertaken as part of sub-regional preparation for the Global Second Early Conference in Bonn embraced the emerging principles and components of EWS (Villagran et al 2003; UNISDR 1997).

A consultation on the results of this study and others in Latin America was characterized as the first event of its kind in the American Hemisphere. Focusing on the context, current Status and future Trends the results of the Study and the consultation present a platform for looking at **Early Warning** initiatives in the Caribbean over the last decade and a half.

The Americas Hemispheric Consultation established an articulation for early warning system as "a process which involves three types of actors of the EWS triangle, Figure 2. These include **scientific and technical institutions**, which are in charge of studying and monitoring natural events to provide models which can be used to forecast events in terms of intensity, time, and geographical span. **Authorities and Civil Protection Agencies**, which are in charge of establishing operations frameworks related to preparedness and response in case of events. **Communities**, which must understand the nature of the hazards, their possible intensities and ranges, and react according to preset guidelines provided by the civil defense institutions in conjunction with authorities (Villagran et al 2003). It should be noted, as discussed at Section 2.0 above, that although the articulation may vary, these are the three elements represent the basic tenets of an effective early warning system (Glanz 2004; UNISDR 2003).

There was general recognition that early warning systems were established for the more frequently experienced hazards (floods and hurricanes) and that the information and communication technologies were being introduced into the EWS process. The study acknowledged the embryonic work in the development of tsunamis, volcano and forest fires and explored the constraints for the limited efforts in EWS for other types of phenomena such as landslides, earthquakes, climate change, and El Niño. It concluded that in the majority of these cases, the main problem was related to the poor understanding of the phenomena, which did not allow for precise forecasting and the lack of adequate resources to implement and operate the systems (Villagran et al 2003).

There was general recognition that early warning systems were established for the more frequently experienced hazards.

Another key observation emanating from the Villagran et al. 2003 study was the lack of public policies specifically dedicated to early warning. The significance of this finding was mitigated by the proffering that there are existing disaster reduction public policies which encompass early warning.

This is the backdrop against which the EWS initiatives and studies in the Caribbean over the last 15 years are reviewed. In the overview of these EWS initiatives there is an opportunity to reflect on the diversity of hazards for which EWS have been elaborated, the use of ICT, the diversity and scope in the EWS components considered. It also presents the space for exploring how far we have moved in EWS since the Valliagran et al. study in 2003.

3.2 The evolution

Since 2000, there have been at least three major studies to assess EWS in the Caribbean. These include the 2003 Caribbean EWS Study (Villagran et. al 2003; UNDP 2008; the WMO 2011). In addition, there has been a diversity of regional and national level EWS interventions, Table 1, covering all dimensions of EWS. Of the 25 Caribbean interventions (projects, reports, studies, research) reviewed at least 75 per cent of these have sought to address more than two components of EWS, or more than one dimension of the EWS triangle. Our data suggest that the majority of the interventions focused on the warning tool, equipment and capacity building components of the early warning system (Figure 3).

Table 1: Regional and National EWS interventions

PROJECT/ INITIATIVE TITLE	YEAR/ PERIOD	COLLABORATORS	OBJECTIVES
CADM II	2009-2012	CDEMA (lead), UWI, CIMH, University of Guyana	Enhance community resilience to the flood hazard in the CDEMA Member countries.
CRMI: Phase I	2004	Cuba and Barbados/OECS UNDP country offices, partners and other UNDP country offices in the region	Increase capacity through south–south collaboration and the identification and exchange of existing technical capacities.
CRMI: Phase II	2010	UNDP	
OCT R3I	2009-2011/2012	UNDP	Provide a network of regional infrastructure, programmes, policies and protocols to strengthen their capacity to predict and prepare for natural hazards. It is hoped, improve resilience and reduce risk and subsequent loss
Community Alerts Project	*2013-2014*	UNDP, CDEMA, FRC, NDOS	Improve awareness to natural hazards and the associated preparation and response protocols in 6 pilot communities Demonstrate Common Alerting Protocol (CAP) as a process to improve community alerting with a view to wider application within the pilot countries and other Caribbean states

PROJECT/ INITIATIVE TITLE	YEAR/ PERIOD	COLLABORATORS	OBJECTIVES
CHAMP	*date not included but proposed to span 3 years*	CDERA, OAS	Develop comprehensive, national hazard-vulnerability reduction initiatives.
ERC Project	2009-2011/12/13	UNDP, CIMH, CDEMA, UNESCO–IOC ICG/CARIBE EWS, the CIMA Research Foundation, and other local and regional partners	Reduce vulnerability and enhance resilience to climate change and natural hazards, drawing on Italian and Caribbean expertise in enhanced civil protection
Strengthening Hydro-meteorological Operations and Services in the Caribbean SIDS	*not included*	FMI, ACS	Increase the capacity of ACS for the strategic planning of the entire DRR process, as well as to enhance the capacities of the NMHSs and DRR agencies
The United States of America/RA IV–WIGOS Demonstration Project (US/RA IV–WIGOS)	*not included*	WMO	Increase the utilization of existing and emerging monitoring and data sharing capabilities
The Carib–HYCOS Project	2008 *(WMO launched initiative in 1993)*	WMO, CIMH, IRD, INSMET	Improve water management to reduce impact of water related hazards/events
The CMO Weather Radar Network	*not included*	CMO	Improve radar network in target countries
Increasing the Capacity of CIMH as a Caribbean Regional Instrument Centre	*not included*	CIMH, FMI	Increase CIMH's personnel capacity and set foundations for future development

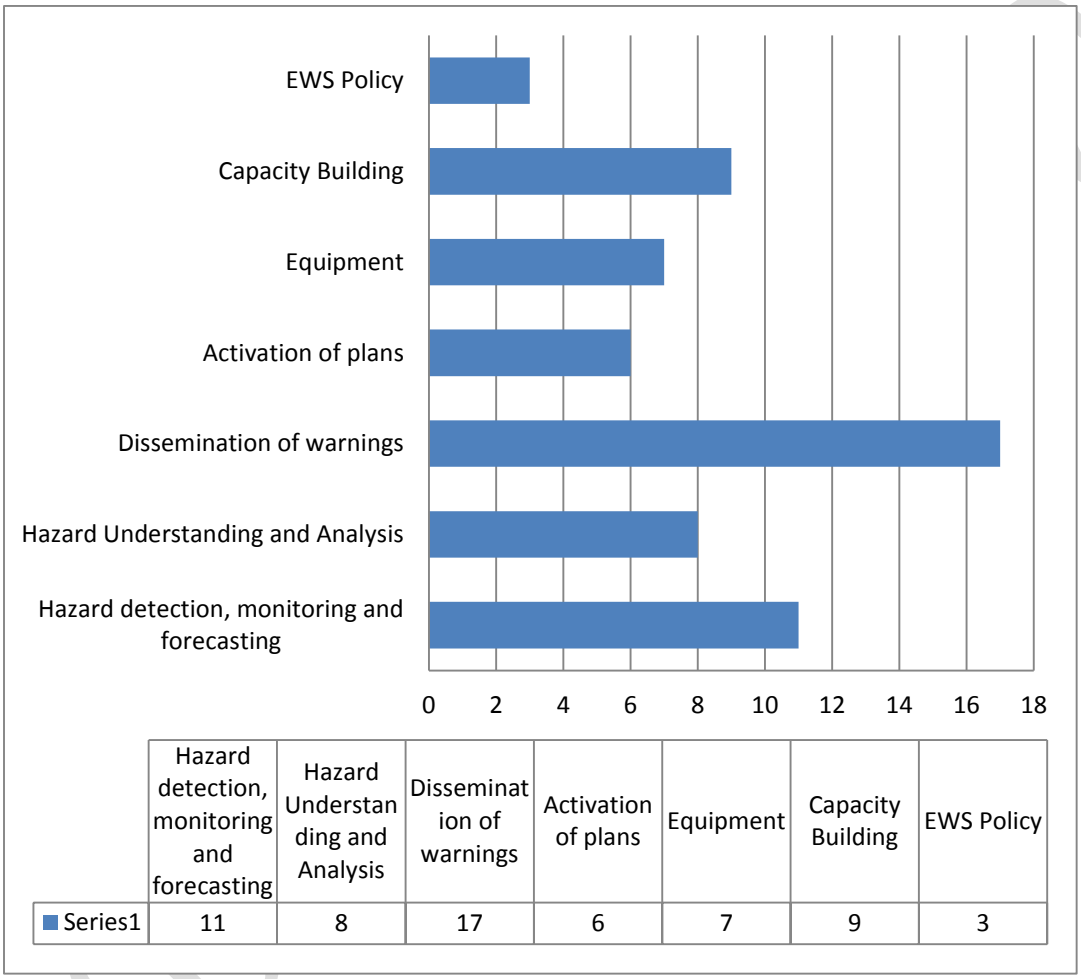

Figure 3: Summary of Caribbean EWS interventions (2000-2015) by EWS component

More than US 57 million was invested in the Caribbean during the period 2005 - 2010 and touched all sides of the EWS Triangle

The review also suggested that post 2003 there appeared to be a significant investment in EWS. More than US 57 million dollars were invested in the Caribbean during the period 2003 -2016 and touched all sides of the EWS Triangle (Table 2). This may be attributed to the increased awareness generated by the discussion of the results of the 2003 Study in the region and the global championing of this cause resulting from the declaration and policy guidance emanating from the 2nd Early Warning Conference in Bonn, also in 2003.

Table 2: Investment in Caribbean Early Warning Systems during the period 2005-2015

DONORS	2005-2010	2011-2015	TOTAL
Australian Aid	1,000,000	-	1,000,000
CARICOM-Japan Friendship Fund		267,466	267,466
CIDA	6,000,000	350,000	6,350,000
DFID	5,000,000	-	5,000,000
European Commission	22,511,600	706,245	23,217,845
Italian Development Cooperation	3,500,000	-	3,500,000
USAID	1,389,680	16,510,000	17,899,680
Total	39,401,280	17,833,711	57,234,991

Source: Author

The contribution of ECHO towards EWS in the Caribbean has been significant and should be acknowledged. Between the period covered by the report it is estimated that 27.878 MEUR has been invested through 51 projects to EWS by ECHO

It is also noted that since 2005 the objectives of Early Warning Systems initiatives in the Caribbean were being articulated within the context of resilience, disaster risk management or other such expression that made a link to development, **Table 1**. The association between this observation and the birth of the Comprehensive Disaster Management Strategy in the region and the global Hyogo Framework for Action is noted and could be the subject of further enquiry.

The salient message is that the convergence of regional and international agendas can be rewarded with increased financial and capacity building support for the vulnerable states of the Caribbean. Growth and diversity in the number of EWS sponsoring entities and project collaborators was also noted.

Clearly, the international development partners, regional organizations, civil society actors and scientific institutions have recognized the need for

concerted action (Figure 4). What is not yet evident is the architecture for consolidating this awareness into a EWS Alliance.

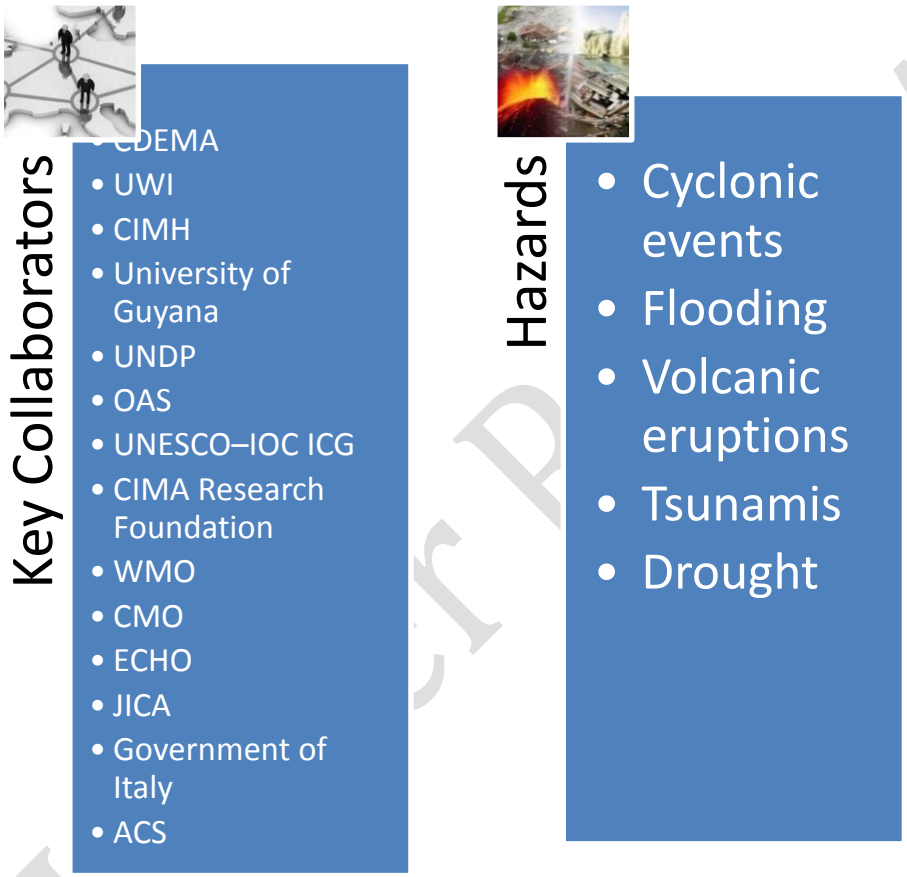

Figure 4: EWS in the Caribbean - Key collaborators and hazards

3.2.1 Hazard specific Early Warning Systems

The Caribbean region benefits from a well–developed warning and forecasting system for hurricanes and other meteorological hazards

The Caribbean region benefits from a well–developed warning and forecasting system for hurricanes that is supported by a network of Doppler radars and satellite imagery strategically place throughout the region in Barbados, Belize, Guyana, Trinidad, French Guiana, Martinique, Guadeloupe, Dominican Republic and Jamaica (Villagran et al 2003; UNDP 2008; WMO 20110). A review of the literature available revealed that all Caribbean countries operate national-level early warning systems for hurricanes based on

information provided by institutions such as NOAA, NHC, WMO, and national weather stations.

Several countries operate sophisticated EWS for floods using telemetric equipment i.e. Cuba operates a warning system for dam breaks and overtopping while Jamaica has a history of community–operated flood warning systems dating back to the 1980s. Although some successes have been seen from the Jamaica system, some aspects of flood forecasting, especially for flash floods, remain problematic, as is the case in other countries and territories. Basic flood early warning systems using simple rain-gauges and river level gauges are also used throughout the Caribbean (Opadeyi 2004, Spence et. al 2004; UNDP 2008).

Drought forecasting is emerging with the work being done by Cuba and the Caribbean Institute of Meteorology and Hydrology (CIMH) 2016; Trotman et al 2010; Lombroso et al 2014).

The Seismic Research Centre (SRC) of The University of the West Indies monitors earthquakes and volcanoes for the English-speaking islands of the Eastern Caribbean. It also manages the Montserrat Volcano Observatory in collaboration with the Institut de Physique du Globe de Paris (IPGP). In addition to SRC's instrumentation, seismographs networks are strategically located throughout Cuba, Jamaica, the Virgin Islands and the Cayman Islands (SRC 2016).

Since 2005, the Pacific Tsunami Warning Centre (PTWC) has been providing interim tsunami advisory services for the Caribbean region which was augmented by services from the National Tsunami Warning Centre in 2007. The Puerto Rico Seismic Network (PRSN) of the University of Puerto Rico at Mayagüez, Seismic Research Centre in Trinidad and Tobago, Instituto Nicaraguense de Estudios Territoriales (INETER) in Nicaragua, Fundación Venezolana de Investigaciones Sismológicas (FUNVISIS) in Venezuela, and other national and regional institutions also provide and/or disseminate earthquake and tsunami information for their areas of responsibility.

On March 1st, 2016 domestic Tsunami services for Puerto Rico, the US Virgin Islands and the British Virgin Islands will be transferred from National Tsunami Warning Center to the PTWC. These changes in the tsunami warning arrangement will require the region to accelerate its capacity to better analyze the tsunami information products provided by the PTWC as this entity will cease to issue Alert, Watches and Warnings for the Caribbean region. The PTWC will only issue tsunami products to pre-determined Tsunami National Tsunami Warning Focal Points (TWFP) and National Tsunami Warning Centers (NTWC).

These agencies will be responsible for analyzing the information and disseminating the corresponding warning messages within their country (Intergovernmental Oceanographic commission, 2015). The Puerto Rico based Caribbean Tsunami Warning Programme, established in 2010, works closely with the PTWC, NTWC, CARIBE EWS and CTIC to provide tsunami products for Puerto Rico and the US Virgin Islands. The (British) Virgin Islands because of its relationship with various Puerto Rico entities will continue to receive the traditional tsunami alert and warning messages from the CTWP.

The formal establishment of the Caribbean Tsunami Information Centre (CTIC), a partnership initiative between the Government of Barbados (GoB) and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organisation (UNESCO/IOC), in September 2013, was envisaged to improve tsunami information and education. The CTIC has the potential to contribute to a Caribbean mechanism that can develop coordinated, comprehensive, regional end-to-end warning system for tsunamis and other coastal hazards. However, the issue of its sustainability is a major concern that has to be urgently addressed (Bolini and Logan 2014).

There is general consensus on the need for multi-hazard approach to EWS and there are many initiatives and discussions among various stakeholders on how this should be operationalized.

3.2.2 Geospatial framework of the EWS interventions

Decision support systems which are used for early warning that rely on geospatial information have increased over the past few years and are increasingly embedded in the operations of regional governments and technical institutions (Farrell 2014; Taylor et al 2014; Opadeyi 2014; UNDP 2008]. The 2009 CDEMA commissioned research on the application of Geographic Information Systems (GIS) for Disaster Early Warning Systems noted that although the Caribbean is vulnerable to a number of natural, technological, biological hazards and social hazards the early warning infrastructure, outside of what is used for cyclonic events, is generally unstructured.
This supports the observations of the Villagran et al 2003; UNDP 2008; WMO 2011; SHOCs 1 2014 and Lombroso 2014.

Decision support systems which are used for early warning that rely on geospatial information have increased over the past few years and are increasingly embedded in the operations of regional governments and technical institutions

In the Caribbean hydro-meteorological early warning is facilitated through the use of radars, satellites, radiosonde devices (small weather station

equipped with a radio transmitter) and augmented by models generated by the National Hurricane Center and data from reconnaissance aircrafts. National meteorological services used this type of geo-spatial data to provide their hydro-meteorological early warning products, CIMH website link.

Additional support for risk-based early warning systems for climate change, increasing climate variability, extreme weather and increasing environmental degradation and change across the region is being developed through the Caribbean Centre for Climate and Environmental Simulations (CCCES) at the CIMH. Established in 2014, at the Caribbean Institute for Meteorology & Hydrology (CIMH) through support from the USAID BRCCC programme, CCCES utilizes state-of-the-art computational resources to conduct complex simulations and analyses within and across disciplines on a range of scenarios (including varying spatial and temporal scales) to adequately identify, bound and mitigate the drivers of risk to the social and economic development of the Caribbean (CIMH, 2016).

The Caribbean DEWETRA platform, developed as part of the Government of Italy funded ERC project through the Italian Ministry of Foreign Affairs, CIMA Research Foundation and the Caribbean Institute for Meteorology and Hydrology" (CIMH), captures impact specific data (loss, damages, injuries, etc.) directly attributable to a hazard event. DEWETRA is a real-time data and information integration for risk forecasting and environmental monitoring that provides warnings for communities exposed to hydro-meteorological risks through a combination of data, forecast tools, and trained forecasters and early warning system operators. The potential effectiveness of the platform is the rapid availability and transmission of data, so that the forecast system can produce up-to-date and reliable forecasts for decision making.

While the platform has been utilized several times in support of decision making when areas of weather disturbance present a risk to the Caribbean, its full potential including the facilitation of a CAP resource is under-utilized (Farrell, 2016 personal communication). A second CAP initiative is seeking to address this challenge.

Seismic activity in the Caribbean region is monitored by the Seismic Research Center using a number of seismic sensors that are located at geologically determined locations around the volcanos. The sensors are equipped with communications devices that transmit detected activity in real time to the SRC in Trinidad. Computer models and scientific intervention analyze the transmitted data to provide forecasting and predictive reports that are shared with appropriate government disaster management authorities for appropriate dissemination to the public (SRC 2016).

Significant progress has been made in volcano early warning since 2003 underpinned by increase monitoring equipment and its spatial distribution, alerting and warning protocols, use of ICTs, partnered research and public education and awareness. The SRC, in our stakeholder dialogue, recognized the need for improved communication on and understanding of its tools to end users. This has been identified as a key result in its strategic plan now under development.

The need to improve the communications dimension of EWS in the Caribbean was recognized by all of the stakeholders consulted in this Desk Review.

3.2.3 Hazard research and understanding: Downscaling from hazard modeling to contingency planning

Central to the development of an early warning system is some type of model that describes the relevant features of the hazard phenomenon and its impacts over time. Hazard modeling allows for projections to be made about future impacts and recommends appropriate response actions. Models varying in their complexity ranging from elaborate physics-based global numerical weather prediction models to those that rely on local knowledge. Models also underlie the other parts of the warning system, such as the likely impacts of a hazard, the way warnings are communicated and acted on, and the dynamics of evacuation processes, but these vulnerability and response process models are generally much less developed than the geophysical process models.

Forecasting is an essential part of flood early warning systems; the link between data collection and issuing a warning, thus highlighting the importance of accurate and timely data and modeling (CIMH 2016, SRC 2012, Taylor et al 2014).

The CADM project, implemented by CDEMA with support from JICA, tangibly demonstrated how the mix of hydrologic science, community knowledge and social science contributions can result in locally owned flood maps and the use of these to inform flood contingency planning in Speightstown, Barbados, Mesopotamia in St. Vincent and the Grenadines and San Juan/Arrangues in Trinidad and Tobago (UNDP 2008; Opadeyi 2008; Spence et al 2004.)

Interventions like the above and those in Jamaica, Guyana and Belize, among others, are beginning to alter the findings of the of the CDEMA 2009 early warning systems study which indicated that the level of metrological and hydrological modeling is at its infancy in the Caribbean. Though it must be acknowledged that the issues of data and staffing adequacy still remain (Lombroso 2014 et al; Farrell 2016 personal communication).

The challenges of integrating data with diverse scales, formats and levels of accuracy, which were also flagged by the CDEMA 2009 Study, are being addressed through a "Big Data Initiative" being initiated by the CIMH, Farrell 2015. Work by the SRC, The Mona Geo-Infomatics Institute and the Geospatial Unit of the Faculty of Engineering of the UWI have advanced research on the incorporation of GIS into HAZUS, which allows users to analyze scenarios and estimate losses from hazards that are not modeled by the HAZUS-MH software, (Geo-Infomatics Institute 2012; Robertson 2014). The Caribbean Hazards Atlas, which was financed by the World Bank, is a product of this research.

Ongoing work by CIMH, SRC and the UWI Climate Modelling Centre in collaboration with regional and international partners has seen a transition to adolescence of efforts to connect models to the needs and practice EWS end-users.

There are signals of efforts to integrate early warning into the disaster preparedness plans with over 85 % of CDEMA PS in 2010 included early warning measures in their contingency planning, Table 3.

Table 3 CDEMA Participating States Disaster Plans with Key Components

Components of National Disaster Plan	Frequency	Percentage
Policy	10	71
Assigned Roles & Responsibilities	12	86
Emergency Powers	10	71
Resources	9	64
Preparedness Measures	12	86
Warning Arrangements	12	86
Response Operations	12	86
Recovery Operations	9	64
Post-disaster Review	8	57
Support Measures	11	79
Other	2	14

Source: Cooke 2011

Hazard modeling and related tools, and platforms, in the Caribbean, are being used to disseminate relevant information to users to help in community-level decision-making. Modern technology including Internet and cellular phones have proven to be very efficient in delivering real-time information that is appropriately downscaled and thus understandable to various end users taking into account gender, age, language, social status, educational, access to technology and means to react. Short Message Service (SMS) technology from cellular providers is used with varying levels of success throughout the Caribbean.

All CDEMA PS had structured programs with Cable and Wireless (CW) in the since 2008, built on MOU between the CDEMA CU and CW. Since the advent of new telecommunications providers in the region PS have been moving to structure similar agreements with new carriers and in some cases to forge relations among them for the purposes of strengthening response planning.
In addition to these national level agreements, IFRC has an arrangement in place with DIGICEL that covers almost the entire Caribbean. Of particular

note is the use of TERA which was able to communicate with the entire population in Haiti by sending early warning SMS alerts. The impact of this system was enormous both in terms of effectiveness as well as the percentage of the Haitian population that was covered by this system (IFRC 2013).

Notwithstanding the benefits of SMS technology as part of a national EWS, countries are exploring the possibility of using the cell broadcasting services which provides a one-to-many geographically focused messaging service.

What one sees emerging in the Caribbean are the elements of an integrated multi-hazard early warning architecture (Figure 4); the linkages and interactions among all the elements necessary to effect early warning and response, the role of the human elements of the system and the management of risks rather than just warning of hazards and a move away from the organized, linear and largely unidirectional delivery by experts of warning products to users.

Such a development requires the careful husbandry of the process and people dynamics. A Caribbean Early Warning Alliance may provide the technical and governance architecture for managing the issues of prioritization and resourcing that are likely to surface.

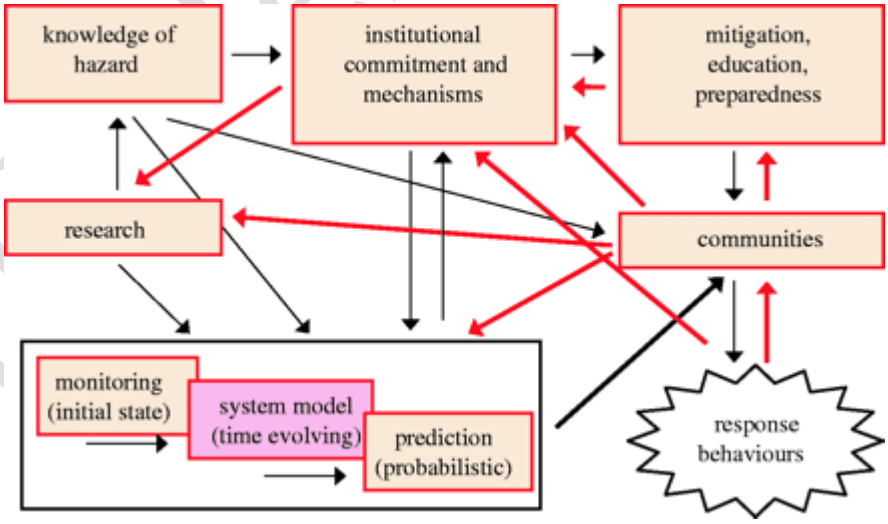

Figure 5 Enhancing early warning systems (Basher 2006)[1]

[1] This concept, as proposed here and illustrated in figure 5 emphasizes the following characteristics: the linkages and interactions among all the elements necessary to effective early warning and response, the role of the human elements of the system and the management of risks rather than just warning of hazards. The black arrows represent the inclusion of actors that often are not recognized as part of the warning system, most notably the political-administrative supporting entities, the district and community actors and the research community. Relating to the red arrows this relates to the explicit inclusion of multiple linkages and feedback paths, particularly from affected populations through their organizations to the political and technical actors.

The 2003 Early Warning Systems study (Valliagran et al) revealed that all of the countries that completed the Early Warning System Survey in 2003 indicated that they have developed or are in the process of developing a range of systems, services and tools that facilitate early warning. Support for these systems was provided through a diversity of government organizations, bi-lateral arrangements and international donors. Subsequent studies, CADM 2006 and WMO 2011 have suggested that the nature of the EWS landscape is slowly changing. Lombroso et al 204, characterized it as mixed.

Efforts have been made in several Caribbean countries through projects like the (a) Caribbean Disaster Management Project, (b) Caribbean Risk Management Initiative Phases I and II, (c) Caribbean Overseas Countries and Territories Regional Risk Reduction Initiative, (d) Caribbean Hazard Mitigation Capacity Building Programme and the (e) Enhancing Resilience to Reduce Vulnerability in the Caribbean project to enhance hazard understanding and the importance of public participation in increasing the effectiveness of disaster risk reduction strategies.

Government buy-in and sector engagement has evolved over the years. However, the divide between scientific research, risk legislation and risk management, though diminishing, still exists. Efforts to involve at-risk population in the development of the early warning systems are also improving but need to be accelerated.

However, the divide between scientific research, risk legislation and risk management, though diminishing, still exists.

The issue here is how preparedness and response architectures, which are primarily cyclone centered, can be adjusted to recognize the importance of organization flexibility and the changing hazard landscape. The expectation of change in the behavior of tropical weather associated with changing climate and resulting increases in catastrophic and extreme events require more discussion on “tame” and “wicked” problems and the implications for disaster management systems (Collymore 2014), including Early Warning Systems.

3.2.4 National EWS Policy

The purpose of EWS policies is to establish authority for system administration, control, access, maintenance and use of disaster alert, notification and warning systems.

In **Table 3** above, seventy-one percent of CDEMA PS indicate the existence of an early warning Policy. The observation of the 2003 Caribbean EWS Study that often specific EWS Policy may not exist but policy guidance may be deduced from other DRM related instruments.

In Guyana, the National Early Warning System (EWS) policy seeks to provide the necessary framework for the national disaster office, the Civil Defence Commission (CDC), to analyze data received from various agencies and issue warnings.

In addition to the warnings issued by CDC, the policy also allows for the naming of alerting and warning authorities and the establishment of the associated protocols. The EWS policy outlines the roles and responsibilities, including those agencies at the technical levels. It also provides for the dissemination of information in interior locations using different types of technology such as telecommunication and social networks.

Improvements in the articulation of National Early Warning architecture are being observed despite the general dearth of EWS policy guidance. The Virgin Islands (British) has invested significantly in all dimensions of the EWS Triangle (Penn 2015) and its efforts may be considered for good practice documentation.

Though they are conceptually and schematically strong National EWS architecture, for example in Anguilla, Jamaica and the Virgin Islands (British), there has been no formal evaluation of their performance. In order to measure benefits and performance of EWS we must have a systems culture that sets and achieves well-defined performance objectives and standards.

The adoption of performance standards for EWS, and indeed other areas of DRM, should be encouraged.

Consequently, it was challenging to respond to one of the specific questions of the study as to "What examples exist of seamless integration of national and community early warning systems?"

The expectation of such a question appears to be rooted in the idea of good practice case study. Though case study identification is not a direct output of this Desk Review suggestions are made with respect to the framing of such at 6.0 below.

4.0 EWS IN NATIONAL AND REGIONAL WORK PROGRAMMES

An effort was made to examine if and how EWS is articulated in the planning frameworks or work programs of the regional and multi-lateral organizations identified as key stakeholders in the study. The intent was to see how high in the strategic intervention chain is EWS anchored, if it is specifically expressed at all. Strategic placement is seen as a proxy indicator of how stakeholder organizations are preparing themselves to lead or contribute to the emerging transition in the Caribbean from systematic end to end systems to those that are integrated.

At the national level the CDEMA summary of work programs of its Participating States and its DRM Audits were reviewed to see the country level efforts in EWS (Cooke 2011; Mahon 2014). This was intended to suggest EWs demand and scope. A constraint in this direction of analysis was the inconsistency of the PS submissions over time.

At both the national and regional level programming EWS contributions were usually wrapped up in other DRM initiatives and distilled at the level of EWS component outputs.

Looking at the work programs and evaluation reports on the work programmes of regional organizations and country level disaster offices, the following are clear:

4.1 Regional level

There is evidence in some organizations, especially like CDEMA, of the consistent specific inclusion of early warning strategic outcomes in their multi-year programming. This trend has been so for the last 15 years and it is projected to be a key component up to at least 2024 as part of the 2014-2024 CDM Strategy and Programming Framework.

In the CIMH though EWS may be considered as a key component of its mandate, it is only in recent years that the institution began elaborating a strategic framework. Efforts are currently underway to elaborate a strategic plan that better reflects its contribution to EWS in the region and beyond.

At the SRC initiatives are unfolding to streamline, in a multi-year environment, key elements of its routine tasks related to EWS. Similarly, at UNDP/Barbados OECS in the last 8 years there has been an increasingly focused effort to link EWS into the UNDAF process as key components of environment resilience, development and climate change. Whereas specific early warning activities have not always been identified UNDP has taken the advantage of opportunities to structure early warning system interventions within those broader outcome areas.

This has been evident with the R3i CAP component and the ERC project. In the IFRC, EWS is also wrapped up in higher level community level or development results and is deciphered at the activity level.

4.2 National level

At the national level there is high variability in the articulation of EWS outcomes and results, outputs in country work programmes. This level of analysis is important because one is seeking to make the connection between very broad thematic areas in the DRM agenda and country uptake and prioritization with respect to how these are articulated. The suggestion, clearly evidenced in the 2003 Caribbean EWS, study that EWS may not be always articulated but is reflected in the broader DRM programmes is slowly changing. However, given the consistency with EWS which it is mentioned in post impact assessments there may be a need to further explore why it is not explicitly articulated in country work programs. One can speculate, based on stakeholder dialogues, that early EWS interventions are opportunistic driven by post-disaster events and donor programming interests. This is an area for further enquiry.

The demand ratio between EWS prioritization and its benefits needs further exploration and presents an opportunity for advancing the interface between the issues of climate services and EWS and the measurement of this to the society at large.

Key actions steps required include:

a. Making EWS results more explicit in work and strategic plans of all stakeholders
b. Agreeing on a suite of indicators to be considered for measuring EWS performance
c. Adopting standards for measuring early warning systems performance

5.0 KEY ISSUES FOR CONSIDERATION

There is general consensus that Early Warning Systems have greatly benefited from recent advances in communication and information technologies and an improved knowledge on natural hazards and the underlying science (SHOCS 1 2014; Cooke 2011; Mahon 2014; WMO 2011). Nevertheless, many gaps still exist in the uptake of these in support of in preparedness planning and crisis decision making. Operational gaps need to be filled for slow-onset hazards both in monitoring, communication as well as the preparedness and response phases (Trotman 2010 et al). Effective and timely decision-making is needed for slow-onset hazards.

Key areas for consideration

- Progress made but still room for improvement
- Early warning communications need to be addressed
- Efforts to engage all stakeholders in the EWS triangle must be accelerated
- Strategic vision for EWS development must be established
- EWS governance framework must be revisited and strengthened
- Cooperation around a Shared EWS Agenda must be strengthened
- EWS within the Context of Climate Services must be considered
- EWS Monitoring Evaluation and Reporting should be addressed

5.1 Progress Made but still room for improvement

The interventions in EWS over the last decade and a half have been many and varied. These included assessments, projects and research studies. All point to the need for strategic positioning and more collaboration if change is to be sustained.

5.2 Early Warning Communications needs to be addressed

Recent assessments of existing early warning systems show that in most cases communication systems and adequate response plans are missing (UNDP 2008; Cooke 2011; WMO 2011; Collymore 2015). Even when EWS protocols may have been elaborated there are many instances where limited familiarity and/or conflicting legislative or regulatory instruments compromise effective operationalization (Fevrier 2010).

5.3 *Accelerate Efforts to engage all Stakeholders in the EWS Triangle*

There is a continued call for the promotion of the articulation of the scientific and technical process of data acquisition, hazard modelling and forecasting with local resilience building actions. Scientific information should be interpreted and translated into practical formats for the population and institutions communication and information needs (Taylor et al 2014; Farrell 2014; Opadey1 2014).

This is necessary if more progress is to be made towards the enhanced use of hazard information products for providing disaster and risk scenarios with more practical applications in terms of planning, preparedness and response. There is evidence of the need for more and earlier Stakeholders involvement in the development of new EWS interventions or redesigning of existing ones (Borlini and Logan 2014, p10).

5.4 *Establish a Strategic Vision for EWS development*

The initiation of EWS interventions in the Caribbean as ex post impact opportunities, observed in 2003, appears to be still a reality and may account for some of the omissions of obvious stakeholders, institutions and states from their design and implementation (Lombroso et al 2014).

5.5 *Revisit and Strengthen the Governance Framework of EWS*

Managing the challenge of donor influence in the design components and beneficiary identification has surfaced as an issue resulting in extensive time in the negotiation and conclusion of project implementation plans or their re-articulation after project initiation. Whilst this is best documented by Borlini and Logan 2014, stakeholders expressed this concern in the semi-structured interviews. The region may wish to adopt the Principles of Good Humanitarian Donorship (IGHD 2013), with donor buy-in, as a proactive mitigation measure.

The guidance from the Co-Chairs of the WHS Consultation Report may be appropriate here 'Putting people at the heart of humanitarian action. Those impacted by crises need to be empowered to control their own immediate situation and destinies. Humanitarian actors should consider affected people as equal partners and support them in maintaining their dignity and restoring self-reliance and a path out of dependency'.

5.6 *Prioritize EWS Investments*

Because of limited resources (human and financial) in many countries, it is important to distinguish between what is desirable for an effective EWS and what is essential (Glanz 2004). This speaks to the need for an upfront discussion on priorities, roles and resource requirements and realistic time frames. The synergies between stakeholder programs and projects require more dialogue and cooperation (Borlini and Logan 2014). This is especially required as the region appears to be moving towards an integrated EWS process

5.7 *Work Towards the Consolidation of National Integrated Multi-hazard Early Warning Systems*

There is evidence of many EWS interventions at the community level that are not, or are poorly, synched with the national EWS architecture.

5.8 *Consider EWS within the Context of Climate Services*

Given the reality of the dominance of the hydro-met hazards in the Caribbean some consideration should be given to the assessment of proposed interventions within the framework of the Weather Service Chain Analysis, (WSCA), Perrell 2012. Because climate change is likely to increase occurrence of extreme weather conditions in the Caribbean further development of warning services stretches out over all segments of the service chain from optimized observation down to understandable, timely, and easy accessible warning messages. Full benefits of DRR will require that warning is a balanced element in a larger palette of measures stretching from prevention to recovery (Perrell 2012). This issue may be addressed in conjunction with 5.7 above.

5.9 *Strengthen Cooperation around a Shared EWS Agenda*

Consensus on an early warning systems program in the Caribbean is a key requirement for structured cooperation and collaboration especially where there is a desire to see EWS treated as a subsystem embedded and integrated into larger socioeconomic and political systems (Co-Chairs WHS Consultation Report 2015). There is an opportunity for CDEMA and CIMH and SRC to partner with other regional organizations, development partners and civil society actors to accelerate the cooperation architecture for fuller exploration of synergies. This gap was recognized by these stakeholder institutions and others during the stakeholder dialogues and was strongly encouraged by Borlini and Logan 2014.

5.10 *Address Monitoring Evaluation and Reporting.*

Monitoring, evaluation and reporting are not common features of EWS projects in the Caribbean. As a consequence, it is difficult to assess effectiveness or efficiency. Where there are efforts to address MER the results chain models and indicators articulation are weak (Borlini and Logan 2014; Lombroso et al 2014). Fortunately, CDEMA has recognized this gap and embarked on a programme to address it to include a CDM aligned MER framework and capacity development programing to use the instrument. It needs to be made available to all the EWS stakeholder institutions and gain their support. Integrating the CAP framework for EWS Capacity assessment (UNDP 2012) into the CDM Monitoring and Evaluation Framework should be a short term priority.

When we consider the issues raised in the 2003 Study on EWS in the Caribbean there is much evidence that advancements have been made in last 15 years. These include the deepening of EWS capability and capacity for our most common hazards, floods and cyclones; the advancing of ICT in early EWS; efforts to advance integrated multi-hazard EWS platforms; improving the cooperation among scientific and technical institutions and authorities. However, the change has been variable with respect to the hazard, the place and the space.

The recommendations from the major assessments of EWS in the Caribbean enhancement have not changed significantly. This may well reflect the long term nature of EWS development and the short term approaches of the interventions.

Given the general short time frame of project interventions many of the results remain pilot studies or model tools and can have implications for sustainability.

Enhancing EWS in the Caribbean

Section 3: Enhancing EWS in the Caribbean

6.0 TOWARDS CASE STUDIES OF CARIBBEAN EARLY WARNING SYSTEMS

The UNDP/IFRC had originally requested recommendations of EWS good Case Studies to inform the establishment of an early warning system inventory. However, it was agreed that the available resources and time for the consultancy could not accommodate such an output. Recognizing the potential value of such a product, the Consultant offered to share some exploratory ideas to inform the elaboration of the inventory.

The first step in defining this inventory is the articulation of a EWS Case Study Identification, Selection and Inventory Program. This programme should be a robust and transparent process that allows all stakeholders in the EWS triangle to contribute material with a sense of how this will be assessed. Equally important is the need to promote diversity in the content of the Inventory to reflect its constituents and the needs of its targeted users.

A clearly established and disseminated process for the identification of the potential Case Studies will allow for their shortlisting and then selection. The administrative structure for this process will have to be set up, managed and monitored.

Below, at EWS-CI and EWS-RB, are two draft tools that seek to provide some clarity and transparency in the identification and shortlisting process. These are building on ongoing work and experience of the author in his capacity as the Convener of a Peer Review Network of the EKACDM project

EWS-CI is a tool that could be used in the EWS Case Identification exercise. It is intended for use in shortlisting submissions for the Case Study Inventory. The information therein may also be used to provide guidance to those who are making submissions to be considered for evaluation. EWS-RB is a generic Rubric for quality assurance and final selection. It can provide a facility for targeted feedback to the contributors for the enhancement of their submissions.

The review process will have to be established before consideration of the documents by the reviewers. This may include scoring guides, weighting, blind or other review formats. There may also be a need to drill down on the Rubric elements to enhance the objectivity of the review.

What is being proffered here is the need for:

a. The development of a program and process to advance the EWS Case Study idea.
b. Link the Case Study to a larger regional EWS Alliance agenda, anchored in the CDM process.
c. Explore how ongoing DRM Portal development initiatives can support and sustain this output.
d. Anchor the Case Study idea to DRM Knowledge Management in the region.

Some countries (e.g Cuba) already have some documented case studies on EWS some of which will be captured on the CDEMA portal (www.cdema.org) through the EWS toolkit

EWS-CI: EVALUATION OF EWS CASE STUDY PROPOSALS

Case Title and Summary Description

Thematic Focus/ foci (communities; authorities and civil society; scientific and technical institutions):

Main Geographic/Contextual Scope:

Situated with the EWS system (hazard analysis; hazard detection; notification and warning; capacity building; contingency plan development and testing; EWS policy):

Medium	Highly Likely	Likely	Less Likely	Not Likely/ NA
1. Presented in traditional case document format				
2. Incorporates strong visual content (maps, charts etc)				
3. Incorporates supplementary multimedia materials (embedded links etc.)				
4. Case can be presented in length, narrative style and form to fully engage learners				

Learning Objectives	Highly Likely	Likely	Less Likely	Not Likely/ NA
1. Currency of topic (e.g. addresses recent incidents/emergencies; policy priorities)				
2. Can be directly linked to EWS courses and training plans				
3. Addresses EWS in sufficient complexity: ii. To create new knowledge in focal area(s) iii. To enhance practical operational/technical/ managerial skills iv. To stimulate and motivate problem solving engagement, role playing etc. v. To assess level of practitioner technical/ managerial skills				
4. Can provide learning opportunities for various audiences (students, professionals, policy makers, community level actors etc.)				

Substantive Content	Highly Likely	Likely	Less Likely	Not Likely/ NA
1. Authentic & context driven (i.e. real scenario, likely with real institutions/ actors; driven by an engaging problem, challenge, issue)				
2. Potentially rich sources of primary and secondary materials readily available				
3. Clear and central EWS focus that folds in aspects of sustainable development, environment, climate change				
4. Focal concepts are presented in technical depth and breadth (i.e. not cursory mention or forced insertion)				
5. Opportunities to invoke different or multiple disciplinary perspectives				
6. Can be couched within interesting, realistic legal and regulatory contexts				
7. Raises questions and challenges as well as answers some				
8. Can be regionally applicable across multiple contexts				
9. Can provide clear contributions to policy discourse around the CDM Strategy, Sendai				

Framework, climate change agreements and sustainable development goals				

KEYWORD DESCRIPTORS OF SUBSTIANTIVE CONTENT COVERAGE AND/OR END POINT LESSONS (not exhaustive)	
Descriptor	**Yes/No**
Impacted in last 5 years/ last 10 years	
Natural hazard	
Technological hazard	
National impact	
Localized or community impact	
Use of local knowledge	
Public Participatory Approach	
Leadership	
Internal/ organizational Stakeholder Networks	
External Stakeholder Networks - Public –Public Partnerships; Public -Private Partnership; Public –Civil Partnerships	
Monitoring and Evaluation	
Reporting and Feedback	
Sustainability and replicability	
Practice can be modelled	
Makes use of ICT	
Practice can be reproduced	
Practice is cost -effective	
Operationally effectiveness	
Innovation and creativity	
Practice is efficient	
Practice is easy to use	
Compatible or readily integrated in current strategies	

KEYWORD DESCRIPTORS OF SUBSTIANTIVE CONTENT COVERAGE AND/OR END POINT LESSONS (not exhaustive)	
Descriptor	**Yes/No**
Easily communicated and disseminated	
Reduces operational risks, health, safety	
Strengthened capacities	
Understand/ reduce risk drivers - poverty	
Understand/ reduce risk drivers – rapid urbanization	
Understand/ reduce risk drivers - inequality	
Understand/ reduce risk drivers – governance systems	
Understand/ reduce risk drivers – other	
Underlying social, economic and political process	
New laws must be harmonized with pre -existing legislation	
Multi -stakeholder approach	
Use of risk information in DRR strategies	
Action -oriented research	
Educational and Awareness building achievements	
Behavioral change	
Production and dissemination of public information material	
Responsive governance	
Public action and greater accountability	
Social, environmental and economic resilience	
Investments in DRR by public, private and civil sector	
Strong legislative and institutional arrangement	
Incentivized integrated implementation	
Promote shared responsibility; inclusion; non - discriminatory	
Performance assessment and evaluation of programmes	

KEYWORD DESCRIPTORS OF SUBSTIANTIVE CONTENT COVERAGE AND/OR END POINT LESSONS (not exhaustive)	
Descriptor	**Yes/No**
Evidence -based policy development	
Mobilization of resources	
Local level decision making	
Political space expansion for DRR (inclusive of political will)	
Microfinance, micro insurance initiatives, social protections	
Impact history	
Regulatory enforcement of standards	

KEY INFORMANTS AND STAKEHOLDER SUPPORT

RECOMMENDATIONS FOR INCLUSION/ PRIORITY RANKING

EWS-RB: RUBIC FOR ASSESSING EWS CASE STUDY					
COMPONENTS	**NO EVIDENCE**	**EMERGING EVIDENCE**	**CLEAR DOCUMEN-TATION**	**INSIGHTFUL AND SKILFUL ARTI-CULATION**	**PEER SCORE**
	(opt)	**(1 pt)**	**(2 pts)**	**(3-4pts)**	
1. Case study method described	The CS method is not described.	The description is vague or unclear	The description is clear	The description is clear and includes appropriate detail	
2. EWS Components are defined	EWS C are not defined	EWS C definition is vague and unclear	The definition is clear	Definition is clear and includes appropriate detail	
3. Purpose- what did the case study (CS) seek to achieve? What did the study hope to learn?	The purpose of the CS was not stated	The purpose of the CS was stated but was unclear or very vague	The purpose of the CS was clearly stated	The purpose of the CS was clearly stated and thoughtfully linked to the purpose of the consultancy	
4. How was initiative being reviewed implemented? When?	There is no discussion about implementation.	Description of implementation was very vague and/or superficial	Description of implementation appears to be complete and authentic	Description of implementation appears to be thoughtfully considered and interpreted	
5. Literature review (data collection process; currency of the literature (is this relevant here???) data collection tools)	No literature is cited	Less than 3 citations offered or relevance of citations is questionable or dated.	More than x relevant citations are provided	More than x citations provided were current and appear to be strongly related to the case study and the objectives of the consultancy	
Stakeholders' consultation? Was the nature of the consultation?	There is no discussion about stakeholder consultation	Description of consultation was very vague and/or superficial	Description of consultation appears to be complete and authentic	Description of consultation appears to be thoughtfully considered, interpreted and accommodated	

EWS-RB: RUBIC FOR ASSESSING EWS CASE STUDY					
COMPONENTS	**NO EVIDENCE**	**EMERGING EVIDENCE**	**CLEAR DOCUMEN-TATION**	**INSIGHTFUL AND SKILFUL ARTI-CULATION**	**PEER SCORE**
	(opt)	**(1 pt)**	**(2 pts)**	**(3-4pts)**	
6. What was found out about the subject of the case study and the key areas of investigation?	Findings and/or interpretations are not provided	Findings and/or interpretations appear to be inconsistent or invalid	Findings and/or interpretations appear to be consistent and can reasonable	Findings appear to be carefully considered and interpretation seems insightful and appropriate	
7. Was the information identified as important for the case study sought obtained?	The information generated is not adequate to answer the question posed by the Case Study.	The information generated appears to be somewhat aligned to the purpose and will not clearly answer the question posed?	The information generated is adequate to answer the question posed.	The information generated is clearly structured and aligned to answer the question posed.	
8. Use of Findings	No action plan based on the findings is identified	Actions identified appear unrelated to the findings, inadequate or superficial	Actions identified appear relevant and adequate and provide an opportunity for improving DDR practice	Actions identified appear relevant and insightful to understanding the barriers to DRR practice. They provide good insights in how practice can be improved.	
9. Did the information obtained in the case study require any adjustments to assumptions or methods? Was the hypothesis validated?	Required significant adjustment to assumptions and methods. Hypothesis not validated.	Minor adjustments required to assumptions, outputs and methods.	No adjustments required to assumptions, outputs and methods. Hypothesis is validated.	Assumptions, outputs and methods were clearly articulated and aligned. Hypothesis is validated.	
PEER REVIEWER'S TOTAL					

7.0 THE COMMON ALERTING PROTOCOL IN THE CARIBBEAN

The UNDP introduction of the Common Alerting Protocol in the Caribbean was informed by its perception of a situation existing "across many countries where there are many steps between a notification of a hazard threat being received by the authorities e.g. meteorological office, national disaster office, police department, etc. and being disseminated to the public" (UNDP 2012). The example of **'the Met Office needing to inform the Prime Minister or Governor that a hurricane is approaching, who then gives authorization to the NDO to inform emergency services and district emergency organisations and in the meanwhile the Met Office is contacting the media houses to disseminate information to the general public**' is suggested as the challenge in the communication flow. It is also noted that 'depending on the type of hazard, the process flow, parties involved and dissemination media used may vary. It is further argued that more significantly, for rapid onset events such as a tsunami, such an extensive process reliant on human intervention and repetition, uses valuable time and creates room for error in transmission and misinterpretation, which can lead to greater losses'. This is that context that generates "the case for the Common Alerting Protocol (UNDP 2012). Whilst we can question the accuracy of the characterization of the National Emergency Warning Systems for hurricane and other hazards there is no doubt about the need to address the timeliness and consistency of messaging (Collymore 2015).

The Common Alerting Protocol (CAP) is an international standard for disseminating warnings/alerts/notifications, adopted by the ITU and the Organisation for the Advancement of Structured Information Standards (OASIS), which provides an open, non-proprietary digital message format for all types of alerts and notifications. Version 1.2 (CAP 1.2) was adopted in 2010.

It does not address any particular application or telecommunications method. The CAP format is compatible with emerging techniques, such as Web services, as well as existing formats, while offering enhanced capabilities that include:

- Flexible geographic targeting using latitude/longitude shapes and other geospatial representations in three dimensions;
- Multilingual and multi-audience messaging;
- Phased and delayed effective times and expirations;
- Enhanced message update and cancellation features;
- Template support for framing complete and effective warning messages;
- Compatible with digital signature capability; and,
- Facility for digital images and audio.

7.1 Design Principles

Among the principles which guided the design of the CAP Alert Message were:

- Interoperability - the CAP Alert Message should provide a means for interoperable exchange of alerts and notifications among all kinds of emergency information systems.
- Completeness - the format should provide for all the elements of an effective public warning message.
- Simple implementation - the design should not place undue burdens of complexity on technical implementers

The Benefit of CAP is the facility for replacing single-purpose interfaces between alert sources and dissemination media and serving as a kind of "universal adaptor" for alert messages (UNDP 2012).

It responds to the assertion that "with adequate alerting, people can act to reduce damage and loss of life from natural and man-made hazard events". It also reinforces the goal of selective, targeted, timely and appropriate alerting and messaging.

In simple terms the CAP presents that "the emergency alerting process can be viewed as centered on a country alerting authority having three parts: 1. relevant data and other alerts are communicated as input; 2. the country alerting authority decides on appropriate actions; and 3. alerting messages are then disseminated to various audiences (other authorities, responders). It recognizes that an operational alerting process of today deals with a wide variety of information inputs and that the information relevant to hazard threats comes in from many sources, including sensors as well as people. These inputs are communicated with many technologies (telephone, radio, Internet, etc.). The information takes many forms (raw data, text, audio, maps, pictures, video, etc.), often specific to the type of information service (news wires, weather notices, seismic monitoring, traffic reports, etc.).

The CAP-based approach is offered as a solution to streamlining of the alerting process through tools that convert much of this diverse information into CAP format.

Whilst CAP conversion tools are already available the methodology allows for the building of others as needed.

An essential feature of a CAP-based EWS is a set of CAP sources and news feeds published by country alerting authorities. These CAP sources and news feeds can be hosted anywhere on the Internet and any of three general approaches could be used for such hosting:

1. CAP sources and/or news feeds hosted on a locally managed, Internet-accessible server;
2. CAP sources and/or news feeds hosted on one or more Internet-accessible servers maintained by another alerting authority under a sharing arrangement; and
3. CAP sources and/or news feeds hosted on Internet-accessible servers maintained by external hosting services.

Advancing a CAP is more than information packaging and communication. It requires understanding, or elaboration, of the institutional environment in which the CAP will take place.

These **"pre-cap conditions**" may include greater legal and organizational clarity with regard to authorities and responsibilities in the event of particular types of emergencies, documentation of the Standard Operating Procedures (SOPs) for at least the critical hazards and resourcing for human and physical inputs and services.

The implication is that the CAP assumes the existence of an established and operational institutional platform for EWS. This must be key consideration in launching a CAP initiative notwithstanding the suggestion that the conditionalities noted above need not be addressed before the country can begin to implement a CAP-based EWS (UNDP 2012) since the technologies and procedures associated with CAP-based EWS can be introduced incrementally as its components are generally independent.

Behind this is the recognition of the reality that it is "quite likely that the extreme alternative approach of a comprehensive restructuring of SIDS emergency management would entail unachievable political and resource commitments".

This issue of the reality of the CAP implementation context is not to be taken lightly. The UNDP (2012) also recognizes that an "Appropriate and complete alerting system is a complex challenge given the wide variety of warning systems".

We proffer that CAP interventions must be platformed on a strategic vision for EWS and its integration into the comprehensive CDM agenda at the national level. Where the targeted states are part of a regional mechanism that seeks to establish common standards and frameworks it would also require that there be regional level consensus on a CAP Agenda.

The CAP initiative in the Caribbean has been a useful introduction of a new integrative tool for Early Warning Systems in the Caribbean. The experience and evaluations suggest that this is a very comprehensive, integrated and complex exercise. Duran (2015) in his Final Evaluation Report of the CAP speaks to the need for more stakeholder involvement in the exercise. His conclusions also speak to a level of expected continuity and sustainability, namely at regional scale given the level of CDEMA's and UNDP's regional office commitment. The issue sustainability at the local level and the requirement for additional technical and financial efforts in order to consolidate the results in the Caribbean today are flagged.

Based on the results of the Desk Review at 3.0 above, the issues raised by Duran should be seriously considered with respect to the scope and process for Caribbean CAP.

The Study sees the space for a revisit of the CAP Caribbean designed intervention and the modality of stakeholder engagement. CAP touches on all dimensions of the Early Warning System process including those relating to the fundamentals of protocols, responsibility articulation, alert, designated entities and related protocols. Also the modalities and tools for sharing this information that connects the risk information providers with those to be informed or influenced collectively or individually.

The path to a Strategic CAP Program and vision would be driven by the results of an audit of the Early Warning System instruments and architecture at the national and stakeholder levels, so that, there is up to date mapping of current and planned early warning interventions. Whilst some audits of early warning systems have been done over the fifteen-year period of the Study these have focused on one or limited elements of the EWS. The outputs of the audit can allow for the establishment of EWS Capability Assessment among the stakeholders in the NEWS and REWS (R31 2014). A refinement of the CAP Capability Assessment guide can be initiated and processes for linking it to the National, CDM and Sector MER frameworks established and agreed.

The following are recommended for advancing the CAP in the Caribbean:

a. **Promote a CAP revisit and awareness program among stakeholders at regional and national levels.** These would include the CIMH, the Seismic Research Centre, CDEMA, the Caribbean Public Health Agency, regional Universities involved in the modelling of risk, CDEMA country representatives and civil society actors.

b. **Promote and Lobby for a EWS Stakeholder Group**. This can build on the Stakeholder Facility at the CIMH and integrated into the CDM Harmonization Council governance mechanism.

c. **Advocate for a EWS Strategic Vision and Program for the Caribbean**. This would be anchored in the Global EWS principles and informed by the audits of early warning capacity and capability.

d. Establish a Monitoring and Evaluation Framework for EWS and integrate into the Regional MER mechanism.

e. Launch a Caribbean EWS Alliance.
The above processes can generate the consensus needed to reset the mindset about EWS in the Caribbean. The CAP needs this if the interventions are to be impacting at a scale to make a difference. The Caribbean EWS Alliance can provide a platform for a dialogue with development partners and private sector on the resourcing of gaps in research, skill sets and equipment needed to retool systems of warning for a rapidly changing hazard and technology landscape.

The above submissions do not pre-empt the individual activity that drives the contribution to the CAP achievement goals. Indeed this is the intent. The big question is "what is the realistic CAP expectation in this region?"

CAP requires a change in mentality and the way EWS is practiced in the Caribbean (Bolini and Logan 2014). EWS is not a short term intervention and will require the back drop of the bigger picture of the disaster risk management agenda at all levels.

Anguilla has been a strong advocate for CAP based alerting in the region having a system in place on island that predates UNDP Barbados and the OECS involvement. Both Anguilla and Montserrat have documented case studies on the CAP based alerting both of which will be captured on the CDEMA portal (www.cdema.org) through the EWS toolkit

8.0 IFRC COMMUNITY EARLY WARNING SYSTEMS TRAINING TOOLKIT

The IFRC Community Early Warning Systems (CEWS) training toolkit targets entities with a vested interest in strengthening or building community early warning systems. It emphasizes the importance of the anchoring of CEWS initiatives to national EWS efforts. The Training Toolkit for Community Early Warning Systems is an operational manual that aims to strengthen early warning systems in a developing country context (IFRC 2014). There is no indication of what characterizes a 'developing country context' which signals an urgent need for setting context parameters for adaptation for the Caribbean, if this is a consideration.

The audience of the Toolkit is clear. It is developed as a ready-to-go Training of Trainers (ToT) and Workshop manual targeted at National Societies and Non-Governmental Organizations (NGOs) that are embarking on a journey either to strengthen existing CEWS efforts in a country (joining them seamlessly to national systems) or to create, from scratch, a community-driven EWS as part of a larger Disaster Risk Reduction (DRR) programme.

Our review of the audits of CDEMA Participating States suggests that National Early Warning Systems exist in all of the Caribbean states and territories, though of varying levels of integration. There is evidence of a diversity of community level early warning initiatives in these states and territories. The focus of a CEWS within the umbrella of this Toolkit would therefore have to be on integration and harmonization of tools and processes. Context articulation is important and explicitly encouraged by the designer of the Toolkit.

A Caribbean EWS Training Toolkit would be a useful contribution to the region's growing arsenal of capacity building products. However, it would seem prudent to map the diversity of CEWS interventions, the resource materials and processes embraced as a first step in the decision tree process proposed in the Toolkit. Whilst organization mandates and programmes create space for individual action there has emerged in the Caribbean national strategic program development processes that embrace key international development partners and civil society actors. Here is a critical space for collaborative engagement on the targeting of communities for CEWS interventions that can support long term resource development.

The nature and extent of the change in mindset and practice in DRM that the principles and epistemology of the CEWS require are for too often underestimated. What a Caribbean CEWS portends is more than a project or program. It requires a significant change in the consultative and cooperative engagement models now practiced.

At the regional level there exists a Civil Society coordination facility within the ambit of the CDM Harmonization Council (CHC). It already has demonstrated the benefits of strategic and collaborative planning in advancing the Vulnerability and Capacity Assessment (VCA), Community Emergency Response Training CERT) and Community Based Response Teams (CBDRT) initiatives in the Caribbean. Given that there exists a political desire for harmonization wherever appropriate this facility can be the medium through which idea of a Caribbean Community Early Warning Toolkit can be birthed.

The following action steps would be important in implanting the CEWS Toolkit in the CDM landscape:

a. Establishment of CEWS Training Working group, within the Civil Society Committee of the CDM Harmonization Council, whose task would be to lead the mapping of existing products, actors and communities early warning systems.
b. Development of an inventory, or plug into existing ones and establish training depth required to support such a program
c. Development, or adaptation, of Principles to inform CEWS in the Caribbean
d. Formulate a strategy for integrating the CEWS within the CDM Knowledge Management infrastructure
e. Explore how the CEWS Toolkit can support the Safe Communities Outcome of CDM 2014-2014.
f. Lobby for a Caribbean EWS Alliance

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusion based on scoping questions

In focusing on the three focus questions of the study we were able to observe following:

9.1.1 Definition of a successful Early Warning System (EWS)?

At section 2.0 we indicated our support for the principles and components of an early warning system as adopted at the Second International Conference on Early Warning and reflected in the recommendations of the 2003 Hemispheric Consultation in the Americas and embraced by WMO.

In this context, a successful EWS has to meet several requirements including the use of appropriate technology and know-how, clear responsibility of the parties, effective decision making support mechanisms, functioning communications systems and supporting preparedness instruments including evacuation planning and response structures.

Additionally, in terms of its effectiveness, we will need to consider the adequacy and timing of the messages and information disseminated as well as the public's confidence in the process.

In the Caribbean whilst we have made significant advances in EWS especially for cyclonic events, there is still much work to be done to meet these essential elements of a successful early warning system.

9.1.2 Examples of seamless integration of national and community early warning systems

Whilst there have been many initiatives at national EWS enhancement and community disaster preparedness for the most part these have not focused on interfacing or where considered have essentially been pursued at the community level. We believe that Cuba through the Risk Reduction Management Center (RRMC) initiative has provided an effective model which demonstrates how the process of national frameworks and community disaster preparedness interfacing can be operationalized. It's exportation to the Caribbean is an important contribution in framing how we proceed on this level of integration.

9.1.3 Reduction in damage or loss of live in the community or country attributed to the establishment of early warning systems

Collymore 2005, in a study on EWS in the Caribbean, highlighted the strong association between the improvement in EWS for hurricanes and the significant reduction in loss of life over a 40-year period. This was generally so for the English speaking Caribbean and Cuba. It was noted however that in Haiti and the Dominican Republic, where these warning systems at that time were not so deeply elaborated, there was sustained loss of life. The real question is how does one relate this to other benefits beyond mortality reduction? It raises the issue of cost benefit analysis, reinforces the call for more research on cost and benefits of early warning interventions and especially for value change analysis of EWS. Above all, there is need to have clear standards for performance and indicators of measurement of effective EWS.

This also reinforces the key consideration made in our study for both the improvement of standards of and better performance monitoring for EWS.

9.2 Recommendations

The Desk Review of EWS in the Caribbean has presented a picture of some progress in advancing early warning in the region whilst at the same time suggesting a need to accelerate the enhancement and engagement processes. The rapidly changing nature of hazards, society and technology calls for an overhaul of the mindset if the enhancement interventions are to impacting and sustainable.

The rapidly changing nature of hazards, society and technology calls for an overhaul of the mindset if the enhancement interventions are to impacting and sustainable

Over the last 15 years there has been observed improvements in early warning systems though this has been variable both by hazard and in space. Movement towards an integrated multi-hazard warning systems culture is evident though this may be characterized as slow. The existing resource deficits, human and fiscal, will dictate the paste at which the region transitions from the dominant techno-scientific warning system architecture to one that embraces all EWS stakeholders. The desire for an inclusive EWS culture in an environment of scarce resources will forge a necessary discussion of the costs and benefits of early warning investments, value chain analysis and prioritization.

To accelerate the advancement of people-centered early warning systems calls for a reset of the mindset that now drives DRM and EWS policy and practice in the Caribbean. It will require a revisit of the placement of EWS in the strategic and operational plans of stakeholders at all levels, the embracing of monitoring and evaluation frameworks and standards for measuring performance.

Additionally, there is a need to examine how EWS capacity needs are reflected in the DRM knowledge management programmes of the region and the required research and product development to support this.

The actors in EWS in the Caribbean are many and their programmes and places of operations equally diverse. There is an urgent need for a facility to harmonize these efforts and share a common Early Warning Vision for the Caribbean. It appears that this is the opportune moment for a **Caribbean Early Warning Alliance.**

The recommendations below are intended to offer ingredients for the change in mindset and the move towards a Caribbean EWS Alliance (Figure 5).

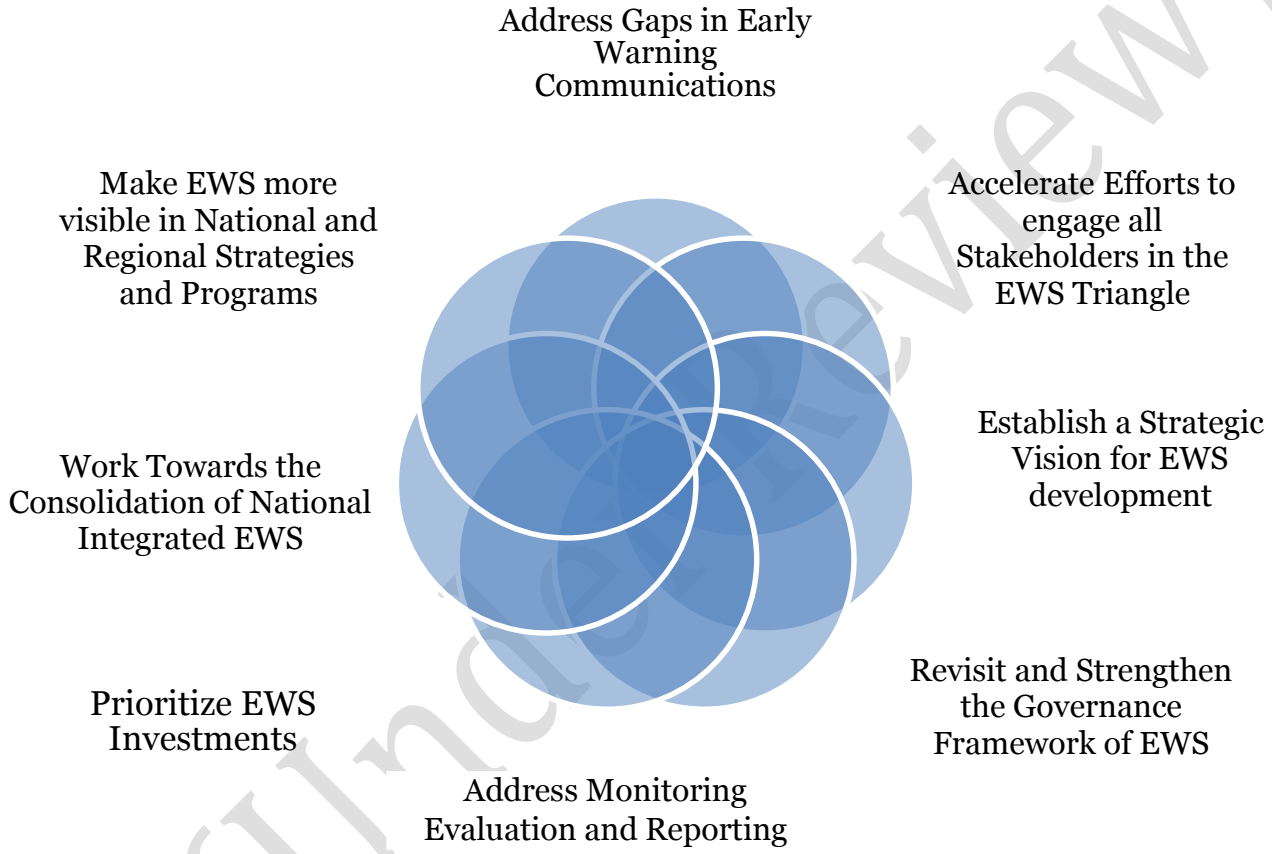

Figure 6: Recommendations for Enhancing EWS in the Caribbean

9.2.1 Address Gaps in Early Warning Communications

Recent assessments of existing early warning systems show that in most cases communication systems and adequate response plans are missing. Even where EWS protocols may have been elaborated there are many instances of limited familiarity with and/or conflicting legislative or regulatory instruments that compromise effective operationalization. Action is required to:

i. Review the provisions of existing legislation for alert and warning

ii. Promote documentation and dissemination of approved protocols

iii. Formalize mechanisms for scheduled testing and public education and awareness of the protocols

iv. Establish a Regional Review Programme of early communications

v. Establish a standard for post impact early warning performance assessment

vi. Assess the CAP as a contributor to the enhancement of the early warning communications

9.2.2 Accelerate Efforts to engage all Stakeholders in the EWS Triangle

This is necessary if more progress is to be made towards the enhanced use of hazard information products for practical applications in terms of hazard analysis, preparedness and response planning. The initiation of EWS interventions in the Caribbean as ex post impact opportunities, observed in 2003, appears to be still a reality and may account for some of the omissions of obvious stakeholders, institutions and states from their design and implementation. The following are suggested:

i. Advance the promotion of the articulation of the scientific and technical process of data acquisition, hazard modelling and forecasting with local resilience building actions.

ii. Interpret and translate scientific information into practical formats for the general population, institutions and public education needs.

iii. Involve stakeholders from the non-scientific community early in the development of EWS interventions and the redesign of existing ones.

9.2.3 Establish a Strategic Vision for EWS development

i. Establish a Stakeholder Working Group to draft recommendations for A Caribbean EWS Strategic Vision for EWS be anchored in the global EWS Principles.

ii. Promote dialogue among stakeholder constituents

iii. Present the EWS Strategic Vision to the CDM Harmonization Council (CHC) for endorsement

iv. Lobby for adoption of the EWS Strategy Vision within a Regional Political Forum

9.2.4 *Revisit and Strengthen the Governance Framework of EWS*

Consensus on a EWS program in the Caribbean is a key requirement for structured cooperation and collaboration especially where there is a desire to see EWS treated as a subsystem embedded and integrated into larger socioeconomic and political systems. There is an opportunity for CDEMA and CIMH to partner with other regional organizations, development partners and civil society actors to accelerate the cooperation architecture for fuller exploration of synergies. This gap was recognized by these institutions and other stakeholders during the stakeholder dialogues and was strongly encouraged. The following may be considered:

i. Build on the CIMH Stakeholder Facility to establish a broader EWS Stakeholders Forum. Integration of this into the CDM Harmonization Council (CHC) governance process should be considered.

ii. Establish EWS standards for data management, product development and performance assessment.

iii. Establish protocols for harmonized EWS program development

iv. Agree on lead roles and responsibilities of stakeholders.

9.2.5 *Prioritize EWS Investments*

Because of limited resources (human and financial) in many countries, it is important to distinguish between what is desirable for an effective EWS and what is essential. This speaks to the need for an upfront discussion on priorities, roles and resource requirements and realistic time frames. Roles and responsibilities complementarities among stakeholders are crucial as no single entity can effectively address all the needs. The synergies between stakeholder programs and projects require more dialogue, coordination and cooperation. This is especially required as the region appears to be moving towards an integrated EWS process. It is recommended that:

i. Research be undertaken on the cost benefits of existing EWS

ii. EWS investments be informed by the considerations of scheduled audits, results of MER frameworks and by priorities agreed within the EWS Stakeholder Alliance.

9.2.6 *Work towards the Consolidation of National Integrated Multi-hazard EWS*

There is evidence of many EWS interventions at the community level that are not, or are poorly, synched with the national EWS architecture. Key actions steps required include

i. Considering and adopting/adapting the EWS principles and policy guides agreed at Bonn 2003.

ii. Reviewing the IFRC Community Early Warning System Toolkit for adaptation in the Caribbean. The steps towards this are suggested:

   a. Establishment of CEWS Training Working group, within the Civil Society Committee of the CDM Harmonization Council, whose task would be to lead the mapping of existing products, actors and communities early warning systems.

   b. Creation of an inventory, or plug in into existing ones, to establish training the depth needed to support such a program

   c. Development, or adaptation, of Principles to inform CEWS in the Caribbean

   d. Formulation of a strategy for integrating the CEWS within the CDM Knowledge Management infrastructure

9.2.7 *Make EWS more visible in National and Regional Strategies and Programs*

i. Make EWS results more explicit in work and strategic plans of all stakeholder

ii. Agree on a suite of indicators to be considered for measuring EWS performance

iii. Adopt standards for measuring early warning systems performance

iv. Establish a EWS Case Study Program that can facilitate sharing of good practices and expertize sharing.

These recommendations are consistent with those of previous DIPECHO regional meetings (Jamaica, Santo Domingo) where there were presentations and discussions on EWS

10.0 CONNECTING GLOBALLY

The Desk Review suggests that the traction in EWS in the Caribbean is closely bound to the guidance and principles emerging from global discourse actioned through regional collaborating mechanisms and institutions.

The Sendai Framework 2015-2030 and the Secretary General's Report to the General Assembly on the World Humanitarian Summit (WHS) 2016 provide the space for political action, stakeholder collaboration around the kernels of dignity, safety and resilience**.**

The issues identified and the recommendations offered present an opportunity to connect our future investments in EWS to the targets and core principles of these processes. They can assist in framing our blueprint for engagement at local, national, regional and international levels.

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Office of Disaster Preparedness and Emergency Management	10. Horace Glaze, Senior Director, Preparedness & Emergency Operations
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United Nations Development Programme (UNDP), Barbados and the Organisation of Eastern Caribbean States (OECS)	18. Mr. Marlon Clarke, Technical Coordinator, Disaster and Climate Change Risk Resilience