

Chapter 7

A Knowledge Management Initiative in Support of the Caribbean Comprehensive Disaster Management Framework and DRM Capacity Building

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Abstract

Despite global advances in risk assessment and production of data and information on risk, there is little evidence that risk assessments are informing disaster risk reduction. There is need for translation of data and information into knowledge which is understandable and usable. This chapter presents a knowledge management project that was developed in support of the Comprehensive Disaster Management Strategy and Framework, the regional framework which guides disaster risk management in the countries of the Caribbean Community (CARICOM). The project is compared to elements of the UN International Strategy for Disaster Reduction (UNISDR) IKM4DRR Scorecard and suggestions are made for sustaining project outcomes. Creation of a virtual space for co-production of knowledge for the CARICOM disaster risk management community is proposed to support continued development of disaster risk management (DRM) capacity in the region.

7.1 Introduction

The Global Assessment Report on Disaster Reduction (GAR) 2015 reports that global economic losses from disasters have reached an annual average of 250 to 300 billion United States dollars (USD). Mortality and economic losses from extensive risk in low- and middle-income countries are trending upwards, while small island developing states (SIDS) will be hard hit as their future losses are projected to be 20 times more than in Europe and Central Asia (UNISDR 2015). Since introduction of the Hyogo Framework for Action (HFA), investment in risk assessment, risk identification and production of risk information has increased considerably; this is accompanied by growth in the risk modelling community of practice, increased risk data availability, and the scientific and technical capacity to transform data into risk information (UNISDR 2015). However, there is little evidence that risk information is informing development or disaster risk reduction (DRR) programmes and policies (UNISDR 2015). In order for risk information to inform development and DRR,

the GAR's authors conclude that risk information needs to be translated into risk knowledge, i.e. information which is understandable and usable by different users.

The Sendai Framework for Disaster Risk Reduction 2015–2030 states that knowledge management is the basis of understanding risk and lists several activities that would support this process. These include:

- a. collection, analysis and use of data and practical information;
- b. dissemination of information, taking into account needs of different categories of users;
- c. making non-sensitive information freely available;
- d. sharing of experiences;
- e. facilitating the science–policy interface for effective decision-making; and
- f. promoting incorporation of disaster risk knowledge in formal and non-formal education, as well as civic and professional education and training.

Definitions of knowledge management are varied. Wang et al. (2001) define it in terms of an organisation's ability to capture, create, deliver and use knowledge in order to achieve organisational learning. Groff and Jones (2003) state that it is a combination of tools, techniques and strategies to retain, organise, analyse and share business expertise. Rowley (1999) asserts that management entails processes associated with the identification, sharing and creation of knowledge.

The differences between data, information, knowledge and wisdom were considered by Ackoff (1999), who proposed the data, information, knowledge, wisdom (DIKW) hierarchy:

- data represents the characteristics of objects and events;
- data is processed into information in order for it to be more useful;
- information, he states, answers questions such as who, what, where, why;
- whereas knowledge answers 'how to' questions;
- wisdom, he concludes, deals with values and involves the exercise of judgement.

Arven (2013) linked the DIKW hierarchy to risk. He interprets data as input to the risk assessment; information as the risk description; knowledge for the decision-maker is understanding the risk description; knowledge for the analyst is understanding how to do the risk assessment and understanding the risk description; wisdom for the decision-maker is being able to use the risk analysis in the right way; and wisdom for the analyst is the ability to present the results of the analysis in the right way.

The gap between the availability of data and information on risk, translation into knowledge and their application to DRR and development has been considered by various authors. Gaillard and Mercer (2012) believe that knowledge must be translated to action by adoption of an integrated and inclusive approach involving

all DRR actors across scales and including all types of knowledge. In considering the problem, Weichselgartner and Pigeon (2015) state that policy-makers often do not use available research in their decision-making and that researchers do not consider the needs of policy and practice when doing research and do not produce findings in a usable form. They suggest that there needs to be a shift from production of risk information to co-production of risk knowledge that is understandable and usable by multiple users.

UNISDR (2013) considers that knowledge management brings together people, resources, processes and information in order to achieve a strategic objective and includes knowledge translation, knowledge brokering and innovation brokering.

One can conclude therefore that to be effective, the production of knowledge entails collaboration among users and producers of knowledge and that the knowledge produced should meet the needs of the user, must be understood by the user and be applied by the user.

Questions surround whether 'knowledge' can be 'managed', e.g. Wilson (2002). However, the idea of knowledge management and its importance to disaster risk management is accepted by various authors (e.g. Spiekerman et al. 2015; Pathirage et al. 2012; Weichselgartner and Kaspersen 2010).

Management of DRM knowledge should have the aim of reducing the impact of hazards and, thus ultimately, reducing loss of lives, property and economic impact. However as has been stated above, losses continue to increase, despite increases in available data and information. The challenges would seem to include communication between policy-/ decision-makers and researchers (Weichselgartner and Pigeon 2015), how to move from knowledge to action (Gaillard and Mercer 2012), inadequate inclusion of all actors in society (McEntire 2005), and difficulties in integrating research findings into policy and practice (Manandhar and McEntire 2014). Any attempts at applying knowledge management for disaster risk management should seek to address these challenges.

This chapter presents a knowledge management project that is underway in the participating states of the Caribbean Disaster Emergency Management Agency (CDEMA), which is the umbrella organisation for disaster risk management of the Caribbean Community (CARICOM). The project is compared to the UNISDR Information and Knowledge Management for Disaster Risk Reduction Framework and Scorecard to assess integration of knowledge management principles in project implementation. Suggestions for sustaining project outputs following the project closure are made and a pathway for future co-production of knowledge among researchers, policy-makers, practitioners and the private sector is presented.

7.2 Caribbean countries' exposure to hazards

Caribbean countries are exposed to multiple hazards of natural and anthropogenic origin. Each year, several countries are impacted by hydro-meteorological hazards.

Table 7.1 Impact of selected disasters on Caribbean countries

Country: type of disaster, year	Economic impact (US\$ millions)	Impact as a % of GDP/GNP
Grenada: hurricane (Ivan), 2004	889	212
Cayman Islands: hurricane (Ivan), 2004	3,432	183
Jamaica: hurricane (Ivan), 2004	595	8
Guyana: drought, 1997	29	n/a
Jamaica: drought, 2000	6	n/a
Montserrat: volcanic eruption, started 1995	n/a	44% decline in real GDP between 1994 and 1997
Cuba: drought, 2004	3.1	n/a
Haiti: earthquake, 2010	8,000	121% 2009 GNP
Dominica: hurricane (Maria), 2017	164,000	167

Source: Various including ECLAC 2004; National Hurricane Centre 2016; FAO 2016; DFID 1999; Aon Benfield 2018.

Tropical cyclone systems can impact multiple countries, causing loss of life and damage, as was the case with Hurricane Ivan which affected multiple countries including Grenada, Jamaica and Cayman Islands (Table 7.1). Volcanic eruptions and earthquakes occur less frequently, but can be devastating. The eruption of Soufriere in Montserrat, which started in 1995, resulted in 20 deaths and necessitated relocation of the capital to the north of the island after the original site was covered by pyroclastic flows. The most recent major earthquake in the region, in Haiti in 2010, resulted in more than 200,000 deaths (ECLAC 2010).

In Caribbean countries, a high percentage of gross domestic product (GDP) is often generated in areas at risk from hazards. Dilley (2005) lists the following percentages of GDP exposed in at-risk areas from two or more hazards for some Caribbean SIDS: Jamaica 96.3 per cent, Dominican Republic 95.6 per cent, Trinidad and Tobago 83.1 per cent, Barbados 79.9 per cent and Dominica 68.3 per cent (McDonald 1985). In addition, for Caribbean SIDS, climate change will contribute an additional US\$1.4 billion to future losses from wind damage only by 2050 (UNISDR 2015).

The interlinkages between disasters and development have been recognised for some time (Cuny 1983; Anderson 1985; Wisner et al. 2004). Wisner et al. (2004) argue that environmental issues and disasters must be discussed in the context of development policy. Anderson (1985) argues that development should decrease vulnerability by addressing those factors – material, organisational or sociopsychological – which cause vulnerability in the short and long term. She characterises disasters as a failure of development (1985). This development–disaster nexus has underpinned global DRM frameworks since the 1990s and is the platform for priority action in the Sendai Framework for DRR. Appropriate, i.e. risk-sensitive, development is important in preventing or reducing the impact of disasters and in ensuring that development is resilient and sustainable (Wilkinson et al. 2016).

7.3 Risk management approaches in CARICOM states

The Caribbean Community (CARICOM) comprises 15 full and 5 associate member states, extending from The Bahamas in the north to Guyana and Suriname on the northern coast of South America, the Lesser Antilles to the east and Belize in the west. In 1991, the governments of CARICOM established the CARICOM Caribbean Disaster Emergency Response Agency (CDERA), now the Caribbean Disaster Emergency Management Agency (CDEMA). CDEMA participating states as at 2017 are shown in Figure 7.1. CDERA led and co-ordinated the regional effort in disaster management, seeking to focus attention on the disaster development nexus and the need to include disaster risk reduction in regional programming (Collymore 2011). In 2001, CDERA through a consultative process developed the Comprehensive Disaster Management Strategy and Framework (CDM), which voiced a concept of including all segments of society in the management of all hazards through all phases of the disaster continuum (ibid). The 2001 version was updated for 2007–2012 with a stated goal of ‘Regional Sustainable Development enhanced through Comprehensive Disaster Management’. CDM 2007–2012 had as Priority Outcome 2:

An effective mechanism and programme for management of comprehensive disaster management knowledge has been established

Priority Outcome 2 acknowledged the importance of knowledge management to the success of CDM. CDM 2014–2024 continued this trend, with Outcome 2 of the new

Figure 7.1 CDEMA participating states (dark shading)



Strategy being ‘Increased and sustained knowledge management and learning for Comprehensive Disaster Management’ (CDEMA 2014).

The current global framework, the Sendai Framework for Disaster Risk Reduction 2015–2030, emphasises the importance of collaboration and knowledge management to disaster risk management and states the need for the public and private sectors, civil society organisations, academia, and scientific and research organisations to work closely together and to create opportunities for collaboration and for businesses to integrate disaster risk reduction into business practices (UNISDR 2014).

7.4 Background to the Enhancing Knowledge Application for Comprehensive Disaster Management (EKACDM) project

In 2004, CDEMA undertook a study on Disaster Management Teaching and Research in Caribbean Tertiary Level Institutions. It revealed that:

- a. There were elements relevant to disaster management in the curricula of different tertiary institutions, particularly at the University of the West Indies (UWI). However, the programmes and course offerings were diffuse and insufficient.
- b. CDEMA participating states had been treated to a rich menu of learning opportunities in several aspects of CDM. However, in most instances, these were ‘one-off’ seminars, workshops and courses of short duration, which, while beneficial to the participants, were not integrated into a structured programme that could be regionally institutionalised.
- c. A diverse set of tertiary institutions were already offering lectures, courses and modules in a few relevant subject areas, but there were gaps in both teaching and research of disaster risk management that required adequate coverage.

The study concluded that CDEMA should emphasise the region’s need to develop multidisciplinary training and research programmes on disaster risk management and discuss with the University of the West Indies whether it could be the focal point to ensure such programmes were implemented.

The University of the West Indies (UWI) is a regional education institution serving 16 Commonwealth Caribbean countries through four campuses – Mona Jamaica, Cave Hill Barbados, Saint Augustine Trinidad and an Open Campus offering distance education. The UWI Strategic Plan 2012–2017 states that UWI is charged with assisting with the resolution of development issues facing the region and supporting the inclusive development of the Caribbean region. In this context, UWI provides technical support to a range of CARICOM institutions, including CDEMA.

Based on these discussions and taking into account the recommendation of the 2006 CDEMA report and a stakeholder consultation process, UWI established the Disaster Risk Reduction Centre (DRRC) to, inter alia, contribute to sustainable development in the region and to advance UWI’s DRM programme. At about this time, in discussions with CDEMA and UWI, the idea was mooted that a knowledge management project would be developed which would address some issues raised

by the reports, as well as supporting CDEMA's CDM Strategy and Framework. Thus, the idea of the Enhancing Knowledge Application for Comprehensive Disaster Management (EKACDM) project was born.

In 2013, UWI received funding support from the Government of Canada for the project. The purpose of the project is to establish an effective mechanism for managing and sharing comprehensive disaster management (CDM) knowledge that is used for decision-making by governments, local communities, the voluntary sector and the private sector. The ultimate outcome of the project is: 'reduced impact of natural and technological hazards and the effect of climate change on men, women and children in the Caribbean region'. The project is led by the Disaster Risk Reduction Centre of UWI's Institute for Sustainable Development. Although not conceived as a 'capacity building' project, aspects of the EKACDM initiative – such as increasing research in DRR, training private sector interests, development of academic courses and ensuring access to knowledge outputs – will contribute to the development of DRM capacity in the region.

The EKACDM project was developed specifically to support the regional CDM Strategy and Framework Priority Area 2 which, through two versions between 2007 and 2024, speaks to knowledge management in support of CDM. The project supports fact-based policies and programmes in CDM, underpinned by sound data on hazards, vulnerability and risk, in order to reduce vulnerability and disaster risk. The reasoning is that development of fact-based policies and implementation of effective programmes requires improved data, including gendered data, access to high-quality information on hazards, exposure and impacts, and a cadre of trained men and women who can translate data and information into realistic and effective policy.

Examination of the project's logical framework shows three intermediate outcomes:

1. enhanced *regional network* that generates, manages and disseminates knowledge for CDM and that includes gender issues;
2. increased use of *standardised gender-sensitive education and training materials* for CDM by professionals and students in the Caribbean; and
3. enhanced mainstreaming of gender-sensitive decision-making for CDM in the public and private sectors, in particular small and medium enterprises (SMEs).

Immediate outcomes are:

1.1 Improved knowledge generation in CDM. This will be achieved by three outputs: research facilitated by scholarship and exchange programmes for students and staff of tertiary institutions, as well as staff of national disaster management offices; improved gender-sensitive methodologies in risk mapping, hazard impact mapping and risk assessment; and comprehensive assessment of disaster risk reduction experiences in order to develop good practices and recommendations for risk reduction.

1.2 Improved knowledge management and dissemination in CDM. This to be achieved by electronic dissemination of knowledge products through regional

databases and documentation centres, thus allowing public access to regional CDM data. Publication of technical materials on DRR on websites and through mailing lists, the CDEMA mechanism and journals.

2.1 Improved access to quality multidisciplinary gender-sensitive educational and training materials for CDM. This to be achieved through development of multidisciplinary courses for the public and private sectors and civil society and a training and certification programme.

3.1 Improved awareness of CDM research outputs for policy and practice, to be achieved through development of policy guidelines and frameworks.

3.2 Increased availability of tools for gender-sensitive CDM in two key economic sectors, SMEs and other components of the private sector, to be achieved through development of manuals, modules and online courses for mainstreaming CDM into sectors.

Successful implementation of the project is expected to ultimately result in the reduced impact of natural and technological hazards and the effects of climate change on men, women and children in the Caribbean region. This ultimate outcome is in harmony with the CDM ultimate outcome of safer and more resilient CDEMA participating states.

7.5 Methodology

In an effort to ensure relevance and to engage stakeholders in co-production of knowledge, consultants engaged to produce project outputs were asked to follow a sequence of steps, while having the flexibility of making adjustments as required. These steps followed a mixed methods approach in which data were gathered by survey instruments developed for the specific output required. This was supplemented by key informant interviews and focus group discussions.

Informants were selected from the target stakeholder groups named in the project document from the public and private sectors and non-governmental organisations (NGOs). The informants were then able to recommend other players within sectors – a form of snowball sampling. Data from surveys, information from the focus groups and a review of relevant literature informed development of draft outputs.

Draft documents were circulated for review or, in some cases, were reviewed during face-to-face workshops. A multidisciplinary peer review network of persons from academia, business and civil society also carried out reviews. The final knowledge products reflected all these inputs.

7.6 EKACDM as a knowledge management project

Perusal of knowledge management literature reveals elements common to knowledge management frameworks and processes across authors. Alavi and Leidner (2001) recognise four processes for knowledge management – creating, storing/retrieving, transferring and applying knowledge. Wiig (1997) lists knowledge creation,

development, organisation and leveraging as important aspects. Alazmi and Zairi (2003) list the following factors as being critical to successful knowledge management implementation: creating, sharing, training, transferring and technical infrastructure. Ruggles and Holtshouse (1999), cited in Dalkir and Liebowitz (2011), give as key attributes of knowledge management: generating new knowledge, accessing valuable knowledge, using knowledge in decision-making, embedding knowledge in processes and transferring knowledge to other parts of the organisation.

The UN International Strategy for Disaster Reduction (UNISDR) publication, *Information and Knowledge Management for Disaster Risk Reduction Framework (IKM4DRR)*, sets out some key principles for information and knowledge management. A scorecard is included which allows assessment of the implementation of IKM4DRR principles in programme design and implementation (UNISDR 2013). The framework and scorecard post-date project design and are more suitable for programmes designed for national-level implementation; however, this provides a useful framework within which to assess whether project design and implementation have captured the knowledge management principles enunciated in the framework. The full scorecard is too long to be applied in its entirety here. The sections chosen are those that are more relevant to project design and implementation, viz Principles and Key Concepts, Elements of a Successful System, and Design and Planning. Other aspects of the scorecard, such as Monitoring and Evaluation, Communicating Impact, and Learning from Failures and Good Practices can be incorporated into the project Sustainability Plan. Tables 7.2a, 7.2b and 7.2c show the status of the project with respect to elements of the scorecard.

Table 7.2a Status of EKACDM project with respect to IKM4DRR Scorecard: Principles and Key Concepts

IKM4DRR principle	Yes	No	Partially – EKACDM status
Demand driven	Y		The project was developed as a result of expressed need of stakeholders. Surveys and other data and information gathering activities are integrated into project to inform outputs.
Standards based			Information and data standards have not yet been developed. The project calls for standardisation of training materials.
Collaborative	Y		The information system as planned will be developed in collaboration with regional partners and will allow sharing of data and information at the national and regional levels.
Sustainable			A sustainability plan will be developed and integration with the regional risk information system is planned. Education and training outputs will be integrated into ongoing programmes.
Transparent			Risk information will be available to the public. There is as yet no plan for ongoing evaluation of the risk information system.

Table 7.2b Status of EKACDM project with respect to IKM4DRR Scorecard: Elements of a Successful System

Element	Yes	No	Partially – EKACDM status
Stakeholder engagement and awareness	Y		A stakeholder engagement plan has been developed. Project outputs target various audiences. Collaboration among researchers, practitioners, policy-makers and the private sector is included in project design. Gender is included as a cross-cutting theme.
Identification of stakeholder groups Management, producers, users, communicators of information			Stakeholders from the four groups have been identified.
Inclusion of special groups in stakeholder groups		N	Except for women, special groups are not included in project design.

Table 7.2c Status of EKACDM project with respect to IKM4DRR Scorecard: Design and Planning

Element	Yes	No	Partially – EKACDM status
Analyse IKM4DRR system demand			User needs were taken into account, professionals were engaged at the start of the project. Level of readiness was not assessed.
Assess technology			Open source technology is being used. Social media will be incorporated. User technology constraints have not been identified. Integration of communications systems is not one of the aims of the project.
Plan for sustainability			A sustainability plan will be developed. Integration into the regional risk information system is planned.

Source: Adapted from UNISDR 2013.

Key: 'Yes' shows a high level of good practice; 'No' shows potential obstacles to good practices implementation; 'Partially' shows progress towards IKM4DRR good practice and describes the current state of EKACDM implementation.

The EKACDM project reflects several elements identified as being key principles and good practice in the IKM4DRR Framework. It is demand-driven, collaborative and transparent, with provision being made for establishing a path for sustainability at the end of the project. Other elements of the scorecard have been partially achieved and there are some omissions. For example, special groups as identified in the framework – persons with impairments, the elderly, children and indigenous

communities – are not included in the project, which focuses on gender. Other omissions are outside the scope and remit of the project. For example, integration of communication systems would be the responsibility of CDEMA at the regional level and national disaster risk management offices at the national level. Opportunities to include some elements in project implementation, particularly through an information portal, exist; assessment of technology readiness, for example, will be included in design of the portal and databases; others, such as identification of funding sources and institutional support, can be included in the sustainability plan which is to be developed.

In addition, the project encourages production of knowledge through research by providing scholarships for pursuit of postgraduate degrees, as well as exchange fellowships for short attachments to universities. DRM professionals from national disaster risk management offices are also eligible for these exchanges. This approach not only encourages the creation of new knowledge, but also contributes to building research skills, improving professional development and exchange of knowledge among the DRM community. There are also provisions for dissemination and sharing of knowledge, which include:

- a. technical publications in scholarly journals and/or on websites;
- b. presentations at conferences, including the signature regional CDM conference;
- c. workshops and training events with a variety of stakeholders;
- d. websites and social media platforms; and
- e. development of courses for online delivery.

All project documentation and report outputs will be stored electronically in a database, which will link with databases managed by regional organisations, NGOs, tertiary institutions and development partners, as well as sites housing hazard and risk maps for the region. The database will also contain data and information on historical disaster events, as well as research outputs, and will be accessible to the public.

Knowledge sharing and dissemination are important for the capacity building aspects of the project. Additional capacity building will be achieved by training of small and medium sized enterprises from multiple islands in integrating disaster risk management into business practices.

Stakeholder engagement includes decision- and policy-makers who are engaged throughout the project in different roles. They are members of the project Technical Committee and a Peer Review Network, which is engaged for quality assurance. Policy-makers also act as key informants in interviews and as participants in surveys, which are used to inform the development of project outputs. These outputs will be reviewed by policy-makers at the stage of final drafts and comments will be used to finalise outputs. This engagement should result in products that are relevant to the needs of policy- and decision-makers.

7.7 Discussion

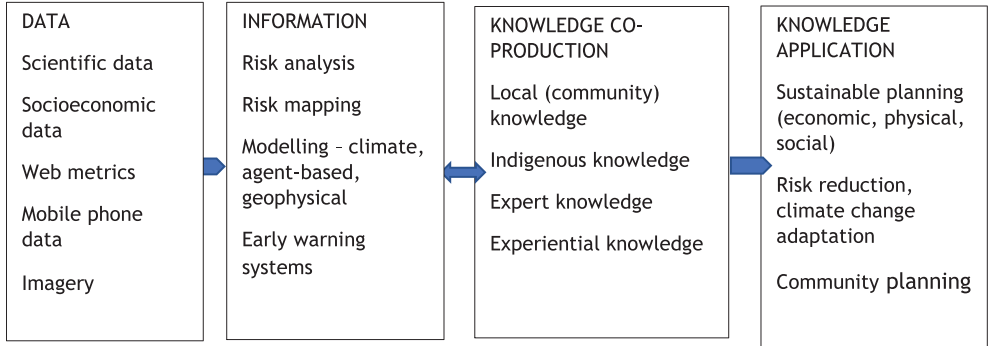
The CDM Framework 2014–2024, in an analysis of results from the previous framework (2007–2012), notes that information on disaster management and preparedness has been available, but there continues to be an impact of hazards on the population, and infers that the problem may be that ‘available information is not translated into life-saving knowledge for the communities at risk’ (CDEMA 2014, 27). Life-saving knowledge must be available in appropriate formats for all communities at risk. It is therefore appropriate to ask whether and how this project will influence the knowledge landscape of CDEMA participating states.

Weichselgartner and Kasperson (2010) emphasise the need for knowledge production that makes connections across disciplinary boundaries, as well as among scholarly enquiry, policy and practice, which integrates a variety of types of knowledge and which engages in collaborative production of knowledge. This, they conclude, will enhance the quality of decision-making. Manandhar and McEntire (2014) seek to link theory to practice, stating that practitioners should seek to incorporate research findings into their work; and calling upon practitioners and policy-makers to include DRR in the early stages of development. The EKACDM project seeks in its design and implementation to provide an enabling environment for interaction among researchers, policy-makers, practitioners and the private sector. Risk assessment methodologies developed or improved by researchers under the project are to be presented to CDEMA for endorsement.

Weichselgartner and Pigeon (2015) note that DRR-informed decision-making and policy require knowledge. However, policy- and decision-making require the right types of knowledge delivered to the right persons at the right time (Pathirage et al. 2012). In an effort to provide the right type of information, the project seeks to address needs identified by stakeholders as expressed in the regional CDM Framework and in consultations carried out during the project. Weichselgartner and Pigeon (2015) suggest that there is a need for integration across scales, multiple actors and knowledge sources to provide relevant knowledge. Gaillard and Mercer (2012) suggest that filling the knowledge-to-action gap requires an integrated and inclusive approach which blends top-down and bottom-up methods, integrates local and scientific knowledge, and includes actors working across all scales. The project includes owners and operators of small and medium enterprises, DRM professionals working at institutional level, as well as national level policy-makers and practitioners. Further, there is an effort to capture the knowledge gained through the experiences of DRM actors at the local through national levels by application of the case study method in which approaches and programmes are studied, analysed and lessons derived. Derived lessons are then distilled into good practices for DRR and documented.

The regional nature of the project means that upon the project conclusion, each CDEMA participating state will decide whether and how it uses the outputs. Knowledge requirements of individual countries vary, as does the ability to dedicate human resources to appropriate and apply knowledge. Figure 7.2 shows possible ways of sustaining project gains. Beyond this, it would be desirable that there be changes in

Figure 7.2 Proposed CDEMA knowledge management system



data, information and knowledge management across CDEMA participating states. The changes proposed here are described below:

- a. endorsement and application of the earthquake impact assessment method as a standard method and continued encouragement of public participation in the build-out of the database;
- b. integration of education and training materials into institutional programmes for online or mixed mode delivery;
- c. continued capture of tacit knowledge through lessons learned and distillation into good practices; and
- d. co-production and sharing of knowledge among all DRM actors and the academic community.

The earthquake impact assessment method is to be endorsed by CDEMA as a standard method, following which it can be used for earthquake response and recovery planning by participating states. The method should be included in tertiary academic programmes. In this way, students could provide support for improvement in the software and method, as well as updating of data. In addition to the training that will be carried out under the project, continued regular training of professionals should be undertaken with the aim of building a cadre of persons skilled in application of the method.

It is important that the EKACDM knowledge products be available to all stakeholders. This will be achieved through project knowledge products being linked to the regional risk information system, allowing access to project outputs, education and training products for the DRM community as well as the private sector, and academic literature and research outputs. Beyond this, many of the courses developed under the project should be integrated into ongoing tertiary-level programmes throughout the region, thus ensuring future capacity building, sustainability and access. A partnership between UWI and CDEMA will see courses being offered to DRM actors as opportunities for professional development.

Capture and sharing of tacit knowledge, which includes information as well as experience, is one of the most difficult aspects of knowledge management

(Spiekermann et al. 2015; Gillingham and Roberts 2006). The EKACDM project can be seen as starting the process of capturing tacit knowledge through the development of case studies and the distillation of lessons learned into good practices. Continuation of the capture of tacit knowledge and its dissemination could be achieved through operational debriefs and evaluation reports, which capture the views and experiences of DRM actors at all levels. Documentation of debriefs and dissemination as a knowledge management product through the regional risk information system would ensure region-wide access. The lessons and good practices derived from case studies can be adopted or adapted by countries. Good practices should be applied, monitored, evaluated and improved upon. Results of application and improvements can be documented and archived. Although debriefs are usually country specific, lessons identified during debriefs could be of wider benefit to other Caribbean countries, as well as to other SIDS. Mercer et al. (2012) mention 'inter-island' networks as a method of fostering knowledge building in SIDS.

There is currently no central co-ordinating mechanism for knowledge management and no established forum for co-production of knowledge in the CARICOM states. The database being established through the project is conceived as a system for archiving, disseminating and sharing data and information. However, there is the potential for it to be more than a database. It is suggested here that it could be designed as a regional knowledge management system. The design could include a virtual space for co-production of knowledge with interaction across scales – community, national, regional; across disciplinary boundaries; and across sectors – policy, research and practice. Scientific data, socioeconomic data and other data, such as data harvested from web metrics, mobile phones, satellites or crowd sourcing, are input to the database. The data are processed and transformed into information such as risk maps, risk analyses, geo-hazard models, climate models and agent-based models.

For the next step, a radical shift from current approaches is suggested – co-production of knowledge. In order to develop the required knowledge products, a multi-stakeholder group would add experiential knowledge, local knowledge and context knowledge to the scientific outputs. These types of knowledge would be obtained through expert opinion, outputs from focus group discussions, and deliberate capture of local and indigenous knowledge. The purpose of this interaction would be to produce knowledge that has the users' input and ownership, is multifaceted, is contextualised and is understandable and applicable for the user, thus improving the capacity of users to apply knowledge to DRR efforts. Documentation of the process and product(s) of the effort and archiving within the database would permit accessibility for all stakeholders. Learning from one country or project would be available for application elsewhere.

The concept is represented in Figure 7.2.

This approach could also be relevant for non- Caribbean SIDS. Mackay et al. (2019) reporting on work done in Pacific SIDS, note the importance of knowledge management meeting the needs of users in order to widen ownership and participation, with the aim of building resilience.

7.8 Lessons learnt

Some of the learning from this initiative may be useful for other small island states implementing similar initiatives. Harnessing the inputs of a wide cross-section of the DRR community and policy-makers not only provided rich input for manuals and policy documents, but also ensured that these outputs were relevant to needs. This approach was also seen as very positive by stakeholders, as stated in evaluations.

All available research opportunities were taken up. The project was important to growing the cadre of young researchers in DRR in the region, as well as supporting ongoing research by faculty. This support for capacity building and generation of new knowledge is a desirable feature of the project which could be duplicated.

One of the gaps identified by stakeholders was inadequate levels of communication by the project. Given its length (five years), complexity and reach, a dedicated communications specialist taken on board at an early stage would have improved project communications.

Over the life of the project, there were two regional conferences at which outputs from the project were shared. These provided the opportunity to reach the wider DRM community which was not directly served by the project. In particular, the DRM community was appraised of ongoing research of relevance to the community and of tools that would support practice. The conferences also provided the opportunity for training selected participants in the seismic impact assessment methodology to be used in the region. Participation was possible as support for the regional conference was specifically included in the project budget.

7.9 Conclusion

The EKACDM project's emphasis on knowledge and its application to CDM reflects the imperative that to understand and manage the drivers of risk, so as to reduce the impact of hazards and disasters, requires appropriate application of knowledge to DRR. The project's design allowed for building regional capacity in DRM by providing scholarships and professional exchanges, increasing access to knowledge products, training and developing graduate-level courses.

The impact of the EKACDM project will not be evident during the lifetime of the project, and there is no provision made for medium- to long-term evaluation of impact. There is an opportunity for scholarship, however, as the academic community could (and should) research the relevance and utility of knowledge created, its uptake and its influence on policy and practice. Practitioners, policy- and decision-makers, and researchers could participate in a longitudinal study on a) whether policy- and decision-makers use the outputs; b) how the outputs are applied; and c) the short- to medium-term impact of including CDM in sectoral policies.

Such research provides the opportunity for collaboration among scientists, practitioners, policy-makers and the private sector, all of whom were involved in the project, and all of whom could contribute to the co-production of knowledge on project impact.

The paradox of knowing better while losing more (White et al. 2001) has been previously mentioned. For more knowledge to be effective in DRR, it must be more appropriately applied by policy- and decision-makers. There is here another opportunity for co-production of knowledge, as scientific outputs could be combined with experiential and local knowledge to produce relevant, applicable and contextualised knowledge for DRR application.

The EKACDM project has a defined lifespan. Gillingham and Roberts (2006) point out that knowledge management is not a 'quick fix' and that its benefits are realised over a period of time. They posit that if knowledge management is to thrive, then capturing, distributing and sharing knowledge must continue. Several opportunities are suggested here to ensure that the benefits of knowledge management started under the EKACDM project are maintained and built on over time.

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