FINAL REPORT for APN PROJECT

Project Reference Number: CBA2012-15NSY-Hiwasaki

Capacity-building to Strengthen Resilience of Coastal and Small Island Communities against Impacts of Hydro-Meteorological Hazards and Climate Change

APN
Asia-Pacific Network for Global Change Research
CAPaBLE

- Making a Difference –

Scientific Capacity Building & Enhancement for Sustainable Development in Developing Countries

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OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

The goal of the project was to increase the resilience of coastal and small island communities in Indonesia and the Philippines against hydro-meteorological hazards and climate change impacts by building the capacities of scientists and non-scientists to integrate local & indigenous knowledge with scientific knowledge. The project took place in the second phase of a larger project funded by the Japanese government and implemented in Indonesia, Philippines and Timor-Leste. In the APN project, the focus was on developing information, education and communication materials targeting coastal and small island communities in local languages in Indonesia and the Philippines that integrate scientific knowledge with local & indigenous knowledge. It is expected that this will in turn result in development of policies, community action plans and climate change adaptation measures that incorporate local & indigenous knowledge. Through this project, scientists and non-scientists in all countries involved—Indonesia, Philippines, as well as Japan and Timor-Leste—learned to work with local & indigenous knowledge related to climate change and hydro-meteorological hazards and climate change adaptation, and jointly developed a tool to integrate local & indigenous knowledge with scientific knowledge. A regional workshop concluded the project, at which the materials, experiences, and lessons learned were shared.

Keywords

hydro-meteorological hazards, climate change adaptation, disaster risk reduction, local and indigenous knowledge, knowledge integration, coastal and small island communities

Objectives

The main objectives of the project were to:

1. facilitate cooperation among scientists and non-scientists in Indonesia, Japan, the Philippines and Timor-Leste and thereby contribute to their scientific capacity-building to integrate scientific and local & indigenous knowledges;
2. build the capacities of scientists and non-scientists to develop information, education and communication materials on disaster risk reduction and climate change adaptation that integrate scientific knowledge with local & indigenous knowledge; and
3. build the resilience of communities living in coastal zones and small islands in Indonesia and the Philippines against hydro-meteorological hazards and climate change impacts.

Amount received and number years supported

The Grant awarded to this APN project was:
US$ 49,000 for one year.

Activities undertaken

1. Organization of a regional workshop "Integrating Local and Indigenous Knowledge with Scientific Knowledge for Knowledge-based Risk Reduction" in Jakarta, Indonesia on 6 – 8 August 2012;
2. Implementation of action research in three sites per country between November 2012 – April 2013;
3. Organization of a regional workshop "Integrating Local and Indigenous Knowledge related to Hydro-meteorological Hazards and Climate Change Adaptation with Scientific Knowledge: Lessons learned" in Manila, Philippines on 18 – 21 April 2013; and
4. Drafting of a publication (with two policy briefs) and papers for submission to peer-review journals (August 2013 – January 2014).

Results

1. Knowledge and capacities of scientists and non-scientists to work with local & indigenous knowledge related to climate change and hydro-meteorological hazards increased;
2. A tool to integrate local & indigenous knowledge with scientific knowledge jointly developed by scientists and communities through action research;
3. Information, education and communication materials targeting coastal & small island communities in local languages in Indonesia and the Philippines that integrate scientific knowledge with local & indigenous knowledge developed by scientists and communities through action research;
4. Cooperation between scientists and non-scientists facilitated through two regional workshops;
5. Dialogue with policy-makers to develop policies, disaster risk reduction community action plans and climate change adaptation measures that incorporate local & indigenous knowledge in disaster risk reduction and climate change adaptation begun, and future steps identified;
6. Publication titled "Local & indigenous knowledge for community resilience: Hydro-meteorological disaster risk reduction and climate change adaptation in coastal and small island communities", which introduces the results of research, includes two policy briefs, and country-specific recommendations, drafted; and
7. Two scientific papers for submission to peer-review journals drafted.

Relevance to the APN Goals, Science Agenda and to Policy Processes

The project is relevant to the APN's Goals and Science Agenda as are clearly stated in its Third Strategic Plan (2010/2015) due to its focus on hydro-meteorological hazards, which are closely interlinked with climate change. Although activities related to disasters caused by natural hazards in Asia and the Pacific region have so far focussed on earthquakes and tsunamis, in light of climate change it is in fact hydro-meteorological hazards that pose threats to people and their livelihoods, especially to those living in coastal zones and small islands. The activity's focus on hydro-meteorological hazards and climate change also contributes to the core strategies of the APN, in that it improves the level of awareness on global change issues that are specific to the region. Hydro-meteorological hazards are having devastating impacts on Asia's coastal areas. Such problems will be compounded by the effects of climate change, such as sea-level rise, more frequent and intense storms, increased rainfall, and warmer ocean temperatures. It is expected that recommendations made in the publication and policy briefs will enable policy-makers in the three countries to take steps to integrate local & indigenous knowledge with science for disaster risk reduction and climate change adaptation. The publication will also be distributed widely at regional and international conferences.

Self evaluation

The project has produced outputs and results as expected. The biggest set-back was the delays experienced in project implementation in the last few months of the project, due to the fact that the information, education and communication materials had to be substantially revised, which was a need recognized by the participants of the regional workshop in April 2013. Predicting that this will in turn lead to a delay in drafting the publication (with policy briefs), a no-cost extension of the project was requested and granted in May 2013. Despite the delay, we are satisfied with the quality of the outputs of the project and are confident that they will contribute to building the resilience of communities living in coastal areas and small islands in Indonesia and the Philippines against hydro-meteorological hazards and climate change impacts. Much advocacy work would be needed to make this happen, which is unfortunately beyond the scope of this project.

Potential for further work

As mentioned above, this project was implemented in the second year of a three-phase project that aims to build the resilience of communities living in coastal zones and small islands against hydro-meteorological hazards and climate change impacts in Indonesia, the Philippines, and Timor-Leste, called "Strengthening Resilience of Coastal and Small Island Communities towards Hydro-meteorological Hazards and Climate Change Impacts (StResCom)". Currently, the results of the APN project are being consolidated and taken one step further to implement the third phase of the StResCom project, during which: (1) information, education and communication materials are being strategically disseminated; (2) the use of knowledge integration tools are being demonstrated; (3) a capacity-building programme for communities, civil society and government officials on the importance of local & indigenous knowledge for disaster risk reduction and climate change adaptation will be implemented. In this sense, the APN-funded project was an integral part of the larger project and substantially enriched the project outcomes and strengthened the expected results. It has played a crucial role in leading the Japanese-government funded StResCom project to its third year.

In addition, further work based on this research that could be implemented is to broaden the scope to a wider range of sites and countries, to use and adapt the tool developed to integrate local & indigenous knowledge with science. This would then lead to revisions of the tool (as necessary) and development of information, education and communication materials in a larger number of sites, thus contributing to increased resilience of communities across the region.

Publications

Hiwasaki, L., Luna, E., Syamsidik, Shaw, R. forthcoming. *Local & indigenous knowledge for community resilience: Hydro-meteorological disaster risk reduction and climate change adaptation in coastal and small island communities*. Jakarta, UNESCO.

Hiwasaki, L., Luna, E., Syamsidik, Shaw, R. "Process for integrating local and indigenous knowledge with science for hydro-meteorological disaster risk reduction and climate change adaptation in coastal and small island communities." To be submitted to *International Journal of Disaster Risk Reduction*.

Hiwasaki, L, Luna, E., Syamsidik, Marçal, J.A. "Local and indigenous knowledge on climate-related hazards of coastal and small island communities in Southeast Asia." To be submitted to *Climatic Change*.

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TECHNICAL REPORT

Preface

The idea to develop a project focussing on local and indigenous knowledge related to hydro-meteorological hazards and climate change was born in 2010. The UNESCO Office in Jakarta, Indonesia, launched the project with generous support of the Japanese Government and the Asia-Pacific Network for Global Change Research. This report describes the research undertaken between 2012 – 2013 in Indonesia and the Philippines under the APN project. As a project implemented under UNESCO's interdisciplinary initiative Local and Indigenous Knowledge Systems (LINKS) programme, it calls for the meaningful inclusion of local and indigenous knowledge in the work of scientists, practitioners, and policy-makers.

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1.0 Introduction

Asia and the Pacific is a region particularly vulnerable to natural hazards. In the first decade of the 21st Century, more than 200 million people were affected and more than 70,000 people were killed annually by disasters caused by natural hazards in the region, which represent 90% and 65% of the world's total, respectively (UNESCAP 2012). According to the World Risk Index, six out of the world's ten highest disaster risk countries are in Asia and the Pacific (Birkmann et al. 2011). Asian communities are thus extremely vulnerable to disasters, which are caused by natural hazards—such as earthquakes, tsunamis, cyclones, drought, landslides, and floods—in combination with environmental degradation such as deforestation, desertification, biodiversity loss, pollution and soil erosion, as well as social factors such as poverty and inequality. Considering that climate change is an important driver of disasters, it is all the more necessary to develop strategies to tackle these two threats simultaneously, and integrate the strategies within wider development contexts (Kelman and Gaillard 2008).

Archipelago and small island states in Southeast Asia—where many poor communities live in coastal areas—are particularly vulnerable to impacts of hydro-meteorological hazards. In the first decade of the 21st Century, the death toll from disasters caused by natural hazards in Southeast Asia constituted nearly half of that in Asia and the Pacific as a whole (UNESCAP 2012). Climate change impacts such as sea-level rise, more frequent and intense storms, increased rainfall, and warmer ocean temperatures exacerbate hydro-meteorological hazards. Thus, not only are coastal and small island (CSI) communities in the subregion prone to more extreme hydro-meteorological hazards, they are also affected by slow-onset changes resulting from climate change such as coastal erosion, coastal flooding, water pollution and loss of coastal ecosystem biodiversity. These pose a direct threat to their livelihoods.

Efforts to mitigate the impacts of hazards and climate change tend to focus on infrastructure development such as building high sea walls, or on high-tech solutions such as sophisticated early warning systems based on scientific data and modelling. These technical and scientific solutions save lives when hazards strike, however, they need to be complemented by actions to address risks surrounding the hazard and the underlying components of vulnerability—the interrelated human, social and cultural factors that influence risk—which can contribute to turning a hazard into a disaster (Wisner et al. 2004). An important component that addresses such risks and that can increase the resilience of communities is their local knowledge. Although recent years have marked the decline of such knowledge, in combination with outside knowledge, it has helped communities manage crises—be it natural hazards, economic problems, or political conflict (Ellen 2007). Evidence that local knowledge and practices can improve disaster preparedness has grown since the 1970s (Dekens 2007b), with many research being conducted (Alcántara-Ayala 2004; Battista and Baas 2004; Campbell 2009; Chan and Parker 1996; Cronin et al. 2004; Dekens 2007a; McAdoo et al. 2009; Parker and Handmer 1998; Rasid and Paul 1987; Roncoli et al. 2002; Scott and Walter 1993; Wisner 1995), as well as indigenous perceptions of disasters and coping mechanisms being documented (Bankoff 2004; Blolong 1996; Campbell 2009; Dove 2008; Lavigne et al. 2008; McSweeney 2002). Globally, the Hyogo Framework for Action (2005-2015) has acknowledged “traditional and indigenous knowledge and cultural heritage” as one source of “knowledge, innovation and education to build a culture of safety and resilience at all levels” (UNISDR 2007: 9).

It is, however, only in recent years that local and indigenous knowledge (LINK) has received increasing attention by both scientists and practitioners. In the aftermath of the 2004 Indian Ocean Earthquake and Tsunami, knowledge that helped indigenous communities survive the disaster was widely publicized (e.g., Meyers and Watson 2008; Rungmanee and Cruz 2005). In fact, the Indian Ocean tsunami has been credited with sparking interest in indigenous knowledge and its integration with science for disaster risk reduction (Mallapaty 2012). The publication of compilations of case studies on traditional knowledge and disaster risk reduction in Asia and the Pacific, such as Dekens (2007b), Shaw et al. (2008) and Shaw et al. (2009), attest to the heightened interest in the topic.

Similarly, social scientists have studied indigenous knowledge and its relevance in our understanding of climate change and adaptation strategies since the 1970s, but recent years have witnessed an explosion of research on the topic. While much of this research focuses upon the Arctic (Alexander et al. 2011; Armitage et al. 2011; Berkes et al. 2007; Cruickshank 2001; 2005; Krupnik and Ray 2007; UNESCO 2009; Weatherheard et al. 2010) and the Pacific (Bridges and McClatchey 2009; Kuruppu 2009; Lefale 2010), other regions of the world are represented in a special issue of the journal *Global Environmental Change* (Salick and Ross 2009), journal *Climatic Change* (Green and Raygorodetsky 2010), compilation of case studies by Galloway McLean (2010) and review of literature by Nakashima et al. (2012). Together, they demonstrate the increasing attention given to the topic. The Intergovernmental Panel on Climate Change (IPCC) acknowledged indigenous knowledge in its Fourth Assessment Report as “an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change" (Anisimov et al. 2007: 673-674). In addition, indigenous peoples themselves have been actively engaging scientists and policy-makers (Anchorage Declaration 2009; IIPFCC 2009; Tebtebba Foundation 2009).

Despite the recognition of the important role local and indigenous knowledge can play in disaster risk reduction (DRR) and climate change adaptation (CCA), such knowledge has yet to feature prominently in climate change policy and science (Adger et al. 2011). Moreover, the increasing number of local and indigenous knowledge and practices documented on the topic of climate change and disasters have yet to lead to increased efforts to translate this knowledge into actions that increase communities' resilience against their impacts.

To attempt to fill the gaps identified above, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) Jakarta Office launched a project focussing on local and indigenous knowledge related to hydro-meteorological hazards and climate change in Indonesia, the Philippines and Timor-Leste. The three-year project, launched in 2011, is funded by the Japanese government through UNESCO Funds-in-Trust. Funding from the Asia-Pacific Network for Global Change Research (APN) was an integral part of the larger project and substantially enriched the project outcomes and strengthened the expected results. It has played a crucial role in leading the Japanese-government funded StResCom project to its third year. The project is being implemented by UNESCO Jakarta Office in collaboration with organizations in the three countries, guided by international experts.

The objectives of the APN-funded project were to:
1. facilitate cooperation among scientists and non-scientists in Indonesia, Japan, the Philippines and Timor-Leste and thereby contribute to their scientific capacity-building to integrate scientific and LINK; and
2. build the capacities of scientists and non-scientists to develop information, education and communication (IEC) materials on disaster risk reduction and climate change adaptation that integrate scientific knowledge with local & indigenous knowledge.

Ultimately, it is expected that the results of this project will contribute to building the resilience of communities living in coastal zones and small islands in Indonesia and the Philippines against hydro-meteorological hazards and climate change impacts.

2.0 Methodology

Local and indigenous knowledge (LINK) refers to the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. According to UNESCO's programme on Local and Indigenous Knowledge Systems (LINKS), for rural and indigenous peoples, such knowledge informs decision-making about fundamental aspects of day-to-day life (UNESCO undated). At the workshop to officially launch the StResCom project held in March 2011, it was agreed that the term local and indigenous knowledge is analogous to terms such as local knowledge, traditional ecological knowledge, indigenous technical knowledge, and endogenous knowledge.

According to Agrawal (1995), up until recently, LINK had been commonly regarded as inferior to science and technology, a factor that hinders the development process of communities. Since the 1990s, however, such attitudes have largely shifted, and the positive contributions of LINK to enable cost-effective, participatory, and sustainable natural resource management have become widely acknowledged by development practitioners (Ellen 2007). It is also around this time that scientists outside the field of anthropology began to show interest in such knowledge as a field of research (Agrawal 1995). The "Declaration on Science and the Use of Scientific knowledge" that came out of the World Conference on Science in June 1999 calls for a broad collaboration between science and local cultures in meeting the challenges of the future, noting that "traditional and local knowledge systems" are "dynamic expressions of perceiving and understanding the world, [which] can make and historically have made, a valuable contribution to science and technology" (ICSU 2002: 2).

The project was implemented with the premise that the two forms of knowledge are equal, with the intent to highlight the former's positive role in DRR and CCA. To implement a project that focuses on integration of LINK with scientific knowledge, participatory action research was chosen as the method for implementing research. UNESCO Jakarta Office, where the project leader is located, acted as the secretariat to the project, and engaged an organization in each country, which implemented the action research. Action research was defined by researchers and advisors of the project as a process which entails involving communities and stakeholders in such a way that they are motivated and willing to engage in a process of guided discovery (Mercer et al. 2008; UNESCO 2011). UNESCO engaged with research institutions in each country, which selected three coastal and small island communities in each country based on criteria agreed upon at the workshop, and implemented action research. Involved in the action research were community leaders and groups (such as youth and women's groups), traditional and religious leaders, local and national governments, local and national non-governmental organizations (NGOs), and local academics and experts. Methods used included field observations, focus group discussions (FGDs), workshops, semi-structured interviews, participatory mapping, and transect walk. Local and indigenous knowledge and practices related to climate change adaptation and climate-related hazards were identified and documented.

As for the research sites and target communities, researchers in each country acknowledged that coastal environmental problems do not just involve people in coastal areas, as they are affected by activities upstream. However, it was agreed that the sites would be defined by the common climate and hydro-meteorological issues they face, namely gradual-onset climate change impacts such as sea-level rise, coastal erosion, drought, and saline intrusion, and sudden-onset phenomena such as storm surges, typhoons, coastal flooding, strong winds, and intense rainfall. Considering that what constitutes a "small island" can be different in each country's contexts, each country had discussions to develop its own working definition.[1] Action research sites were selected to be as diverse as possible in terms of socio-cultural background and geography, thus when possible, one urban coastal settlement, one rural coastal settlement, and a small island were selected (in Indonesia and Philippines, considering the size and diversity of these two countries).

All organizations implemented research under a shared framework, key definitions, and outputs agreed upon by participants at the regional workshops. This way, each organization was working with the same objectives and framework, while leaving room for flexibility to make adjustments according to each country's circumstances. In the Philippines, action research was conducted by the Center for Disaster Preparedness (CDP) between November 2012 – March 2013 in Rapu Rapu Island (Albay), Alabat Island (Quezon) and Angono (Rizal). In Indonesia, action research was implemented in Pulo Breueh and Pulo Nasi Islands (Aceh) and Sayung (Central Java) between November 2012 – April 2013 by Tsunami and Disaster Mitigation Research Center (TDMRC) in cooperation with the Indonesian Society for Disaster Management (MPBI) for Sayung. In Timor-Leste, National Center for Scientific Research, National University of Timor Leste (UNTL-CNIC) implemented research in Lau-Hata (Liquiça), Maluru-Beaço (Viqueque) and Raimea (Covalima) between December 2012 – April 2013.

[1] For example, in the Philippines, according to the Department of Environment and Natural Resources (DENR) Administrative Order No. 2000 – 83, the official definition of "small Islands" is "islands/islets with an area of not more than 50,000 hectares" (= 500km2), whereas in Indonesia, a small island is an area "less than or equal to 2,000 km2" (National Law No. 27 Year 2007 on Coastal Area and Small Islands Management).

Figure 1: Map of project research sites, 2012-2013

© UNESCO, Source of original map: http://www.diva-gis.org/Data

The first activity of the APN project was a regional workshop titled "Integrating Local and Indigenous Knowledge with Scientific Knowledge for Knowledge-based Risk Reduction" held in Jakarta, Indonesia, on 6 – 8 August 2012. Twenty-two participants from five countries representing experts, local and national organizations of targeted countries, government agencies, and UNESCO Office Jakarta participated in the workshop. During the workshop, participants discussed (a) models, self-assessment tools, and methodologies for integrating LINK with scientific and other knowledge for disaster risk reduction and climate change adaptation; and (b) steps and methodologies to implement action research and to develop IEC materials for disaster risk reduction and climate change adaptation.

This was followed by action research to identify, document and validate LINK. Validation was done both by communities and by scientists. Validation with communities involved (a) confirmation that knowledge was widely held in the study area (e.g., by fisherfolk in Aceh) and not just by one or two individuals; (b) existence of proof that the belief, knowledge, or practice has existed in the community for more than one generation; (c) relevance to anticipate or to cope with hydro-meteorological hazards and climate change adaptation; and (d) whether the LINK is still being practised and is effective (i.e., do the expected outcome from the LINK take place?). The scientists and experts then provided scientific explanations or empirical applications as to why the LINK can be used for hydro-meteorological hazard risk reduction and climate change adaptation. FGDs and workshops were organized for community validation and establishing scientific explanations to the LINK.

Based on the results of these processes, self-assessment tools (consisting of guidelines and checklists) were developed in each country. The objective of the tools were to empower coastal and small island communities to use the knowledge and practices they own to better deal with negative impacts of hydro-meteorological hazards and to adapt to climate change. The tools were to help them use their knowledge, in conjunction with science, to reduce their disaster risk and enable them to better adapt to climate change. The tools were piloted in one to three sites in each country, and were subsequently revised as necessary. It is based on these self-assessment tools that the "LINK Inventory, Validation and Establishment of Scientific Knowledge (LIVE Scientific Knowledge)" tool described below was developed.

The organizations then developed IEC materials that integrate LINK with science, such as posters, flipcharts, video, booklets, and cartoons. The method for developing IEC materials are described in detail below in "Results & Discussion" section.

The IEC materials, self-assessment tools, experiences and lessons learned were shared among the scientists in three countries and experts from Japan at the regional workshop titled "Integrating Local and Indigenous Knowledge related to Hydro-meteorological Hazards and Climate Change Adaptation with Scientific Knowledge: Lessons learned". Organized in Manila, Philippines, on 18 – 21 April 2013, the workshop brought together 33 people representing researchers, scientists, experts, government agencies, local and national NGOs, and local communities from Indonesia, the Philippines, Timor-Leste and Japan. As a result of the workshop, the tools and materials were further revised. At the workshop, concrete plans were made to draft a publication (which includes two policy briefs) and papers for submission to peer-review journals. Drafting of the publication and papers was realized at a "write-shop" that took place in Kyoto, Japan, on 1 – 3 October 2013.

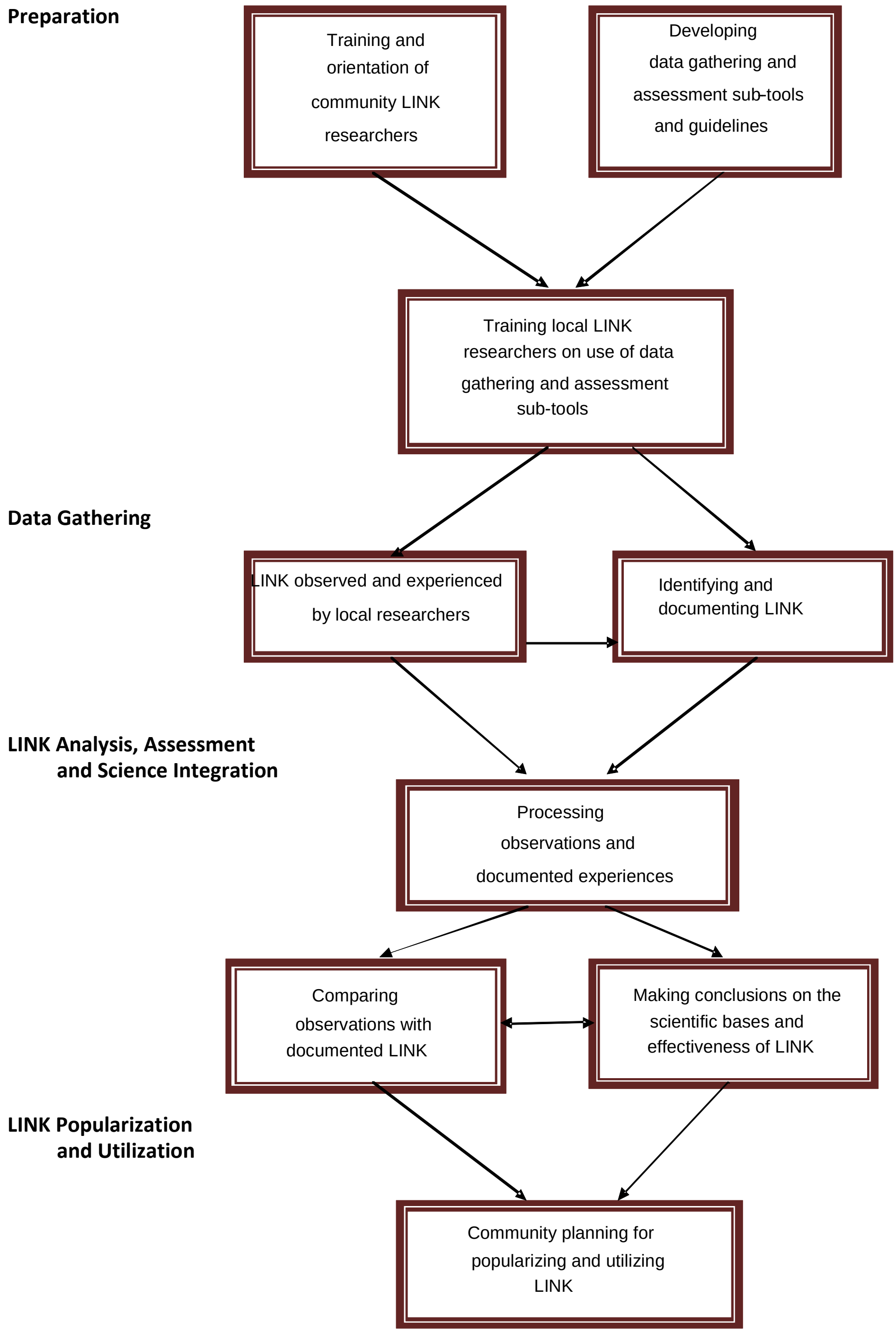
3.0 Results & Discussion

In this section, we discuss two concrete outputs of the project: (1) a tool to integrate LINK with scientific knowledge; and (2) IEC materials targeting CSI communities in local languages in Indonesia and the Philippines that integrate scientific knowledge with LINK. Both outputs were developed jointly by scientists and communities through action research.

3.1 Integration of Local & Indigenous Knowledge with Science

Based on research implemented, we have developed a tool we call "LINK Inventory, Validation and Establishment of Scientific Knowledge (LIVE Scientific Knowledge)" as a community tool for integrating science with local and indigenous knowledge. The tool is based on previous efforts at knowledge integration, such as the one developed by framework by Mercer et al. (2009). Adopting the community-based disaster risk management (CBDRM) approach, "LIVE Scientific Knowledge" enables an integrated process of observing, validating, analyzing and utilizing LINK by the owners of such knowledge themselves leads to knowledge integration and propagation. Since researchers and NGO organizers usually do not permanently live in the communities where action research takes place, it is necessary for communities themselves to have a tool to document and assess their own LINK. It is community-led, with initial support from outside resource organizations such as research agencies or development organizations. The latter provides the initial orientation and training needed by the community so that the former can document, assess, validate and improve the accuracy of their local knowledge on DRR and CCA.

Figure 2: Flowchart of "LIVE Scientific Knowledge"



As depicted in figure 2 above, the LIVE Scientific Knowledge process is composed of the four phases: (1) preparation, (2) data gathering, (3) LINK analysis, assessment, and science integration, and (4) LINK popularization and utilisation. Materials needed for each phase is described in table 1 below.

Table 1: Materials needed for LIVE Scientific Knowledge

Phase	Materials Needed
Preparation	Module for training and orienting local researchers on LINK for DRR and CCA
	Data-gathering forms, data processing sub-tools, and guidelines on how to use them
Data gathering	Data-gathering forms: to be filled by the local researchers when they observe or experience the LINK.
LINK analysis, assessment and science integration	LINK data processing sub-tool: used to tabulate data gathered from observations (LINK observed and documented will be assessed, analyzed, and integrated with science).
LINK popularization and utilization	IEC materials

LIVE Scientific Knowledge process begins with the preparatory phase, when the methodology is selected (i.e., "LIVE Scientific Knowledge" tool), and local researchers are selected and trained on the process and methodology. In the Philippines, a module for training and orienting local researchers was prepared and implemented in each study site. Five sets of data-gathering forms were prepared, one for each category of LINK (i.e., (1) observation of animal behaviour, (2) observations of celestial bodies, (3) observations of the environment, (4) material culture, and (5) traditional and faith-based beliefs and practices). Each form consists of a table that enables the recording of each LINK observed, when it was observed, what disaster event or impact happened after the LINK was observed, and when the impact occurred. While different countries and communities would have their own unique LINK, the form could be used or slightly modified for use in other places. The animals may change from tropical to temperate region, but there would be animals whose behaviour can be observed to predict hazards. The kind of LINK related to celestial bodies may be different, but it would essentially be the same sun, moon, and stars that are observed to predict changes in weather. Although the meaning of each LINK and its impact may differ because of the differences in context, similar categories can be used.

In the data gathering phase, a systematic gathering of data is important and to facilitate this, the same data-gathering form is used by all local researchers involved. The use of such forms promotes standardization of data collected, and scientific and rational thinking process which are composed of the following steps:

- Observation: observing the LINK researchers have identified in their community;
- Recording: documenting observations in the data-gathering form;
- Analysis and interpretation: Giving meaning to the observations and confirming that the expected impact actually took place;
- Making conclusions: From the outcomes of the observed LINK, making measurable and verifiable conclusions.

In this process, selected community members act as local researchers who observe and document LINK by filling in data-gathering forms. Each local researcher can focus on a specific category of LINK.

In the LINK analysis, assessment, and science integration phase, not only are scientific explanations to the observed events or phenomena provided, but each LINK undergoes scientific processes such as:

- Formulating the problem: which is the LINK that can be used for DRR and CCA?
- Data analysis: this involves tabulating frequencies of the observations made, making analysis of the trends, comparing the outcomes, and providing explanations about the outcomes.
- Making conclusions and recommendations: from the analysis, conclusions and recommendations can be made on how to use LINK for DRR and CCA, and which can be integrated with science.

Once the process of observing, recording, analyzing, validating, and integrating LINK is complete, they can be widely disseminated. The steps to be taken to realize the LINK popularization and utilization phase is described below in section 3.2.

3.2 Development of Information, Education and Communication Materials

An important way to communicate the importance and relevance of LINK to communities, especially among youth, is to develop and disseminate interesting, action-oriented, and appropriate IEC materials. Furthermore, IEC materials that incorporate LINK with science for DRR and CCA makes it possible to:

- demonstrate the advantages of practising and adopting LINK for DRR and CCA;
- revitalize and strengthen LINK by demonstrating that LINK can be used to anticipate and mitigate hazards and impacts of climate change. Despite advances in science and technology, LINK is still important to foster the resilience of communities towards disasters and climate change.
- transfer LINK from one generation to the next, and from one community to another.
- show the relevance of LINK found in that community, thus resonating more with the target audience and facilitating the learning process. As LINK is deeply connected to a community's culture, religion, and social and economic activities, placing knowledge in the local context is pivotal to promote the use and transmission of LINK.
- demonstrate integration of science and technology with LINK: this will help strengthen the relevance of LINK for DRR and CCA. When scientific explanations or empirical evidence for LINK are incorporated into IEC materials and disseminated, this can also encourage the scientific community to further investigate LINK.

When promoting the use of LINK using IEC materials, it is important to take into consideration that different CSI communities are affected by different hazards, which occur in diverse environmental and cultural contexts. These contexts affect the medium of material to be developed, target audience, and method of disseminating the materials. A factor considered especially important in the process of developing materials is the religious and traditional belief systems of target communities. At the same time LINK is deeply embedded in a community's beliefs, IEC materials must also take religious sensitivities into account. Materials that demonstrate such sensitivities will be more easily accepted by CSI communities when they are disseminated.

Correctly identifying the audience is another important consideration. Developing and disseminating IEC materials without specifying the audience can potentially lead to ineffective and inefficient results. By targetting the promotion of LINK to a specific audience, it can trigger greater and faster impact. Furthermore, communities usually have key people who act as agents of change. The materials can be made to specifically target such key groups by tailoring to their interests and their capacity to absorb information.

The medium and target audience of IEC materials developed in Indonesia and the Philippines as part of the APN project are summarized below in Table 2, with titles of materials developed in each country.

Table 2: IEC materials developed in Indonesia and the Philippines

Medium	Material developed	Target audience
Comic book	Indonesia: 4 books titled "*Uteun Bangka Penjaga Pantai Kita*", "*Bermain di Uteun Pasie*", "*Belajar Keuneunong*", and "*Angeen Badee sang Perusak*".[2]	Students and teachers
Poster	Indonesia: 3 posters titled "*Angeen Badee*", "*Uteun Pasie*", and "*Uteun Bangka*", Philippines: a poster titled "7K" in Filipino[3]	Local community in general
Audio Visual Production	Philippines: A 25-minute video based on Rapu-Rapu Island	Local community, DRR and CCA practitioners, and scientists
Booklet	Indonesia: 3 booklets titled "*Pengetahuan Asli dan Lokal Angeen Badee*", "*Pengetahuan Asli dan Lokal Keuneunong*", and "*Pengetahuan Asli dan Lokal Uteun Pasie dan Uteun Bangka*"[4]	DRR and CCA practitioners and scientists
Flipchart	Philippines: a 10-page flipchart in English	Trainers and teachers

[2] The English translation of the titles of the comic books are: "*Uteun Bangka*, Our Beach Guardian", "Playing in the *Uteun Pasie*", "Learning *Keuneunong*", "*Angeen Badee, the Destroyer*".

[3] In the Philippines, seven is a lucky number and most words expressing positive attributes start with the letter "K".

[4] The English translation of the titles of the booklets are: "Local and indigenous knowledge on *Angeen Badee*", "Local and indigenous knowledge on *Keuneunong*", and "Local and indigenous knowledge on *Uteun Pasie* and *Uteun Bangka*".

As a result of the process of developing IEC materials in Indonesia and the Philippines, the collaborators involved with the project agreed on steps that need to be taken for people interested in developing such materials that integrate LINK with science, as outlined in figure 3 below.

Figure 3: Steps for developing IEC materials that integrate local and indigenous knowledge with science

Identification of LINK to be promoted
Consideration: can the LINK be clearly validated by science and technology?
Actions: identification, documentation, validation
Done by: local community, traditional leaders, scientists

Determination of target audience
Consideration: what kind of language and pictures can be used?
Actions: discussions with key informants, selection of target audience
Done by: disaster management officers, local community, scientists

Selection of media
Consideration: how practical is it to develop and disseminate the material? What is the capacity of the local community? How complex can the information be?
Done by: local community and scientists
Media: poster, comic, flipchart, booklet, AVP, game, etc.

Material development, validation, and testing of KIDA principles
Consideration: how clear and accurate is the content? Are the materials interesting, and incite action? How effective is the material in conveying the message?
Done by: local community and scientists

Printing and Dissemination
Consideration: How can they be most efficiently disseminated?
Done by: local community, schools, disaster management officers, religious and traditional leaders, scientists

<u>Selecting LINK to be promoted</u>: Although diverse forms of LINK related to DRR and CCA can be found in CSI communities through participatory research using tools such as the “LIVE Scientific Knowledge”, not all LINK would be appropriate to be incorporated and widely disseminated as IEC materials. LINK thus need to be selected taking into consideration a wide range of factors and to ensure the applicability to other communities. In the case of Indonesia, LINK related to coastal protection using certain types of coastal vegetation (*Uteun Pasie* and *Uteun Bangka*) and a traditional calendar system used by fisherfolk and farmers to time their livelihood activities (*Keuneunong*) were selected.

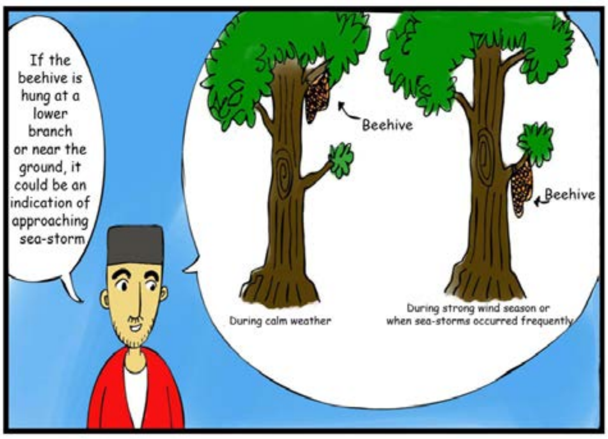
Selecting target audience: To ensure that projected effects are met, the targeted audience needs to be identified. Target audience can be classified based on educational background, occupation, and/or lifestyle, for example, students up until certain grade, people with certain occupations (e.g., fisherfolk or farmers), general public who live in disaster-prone areas, or people with certain interest (e.g., DRR practitioners or scientists).

Determining the media: What form the IEC materials will take also determines the effectiveness of message delivery and impact. The materials should be developed in accordance with the anticipated preferences or activity of the target audience. For example, in the case of Indonesia, several comic books were developed to attract attention of youth, especially those in secondary schools. The comics were drawn by selecting appropriate characters that are close to the context of the targetted CSI communities in Aceh. As most Acehnese are Muslims, some religious messages that are relevant to LINK for DRR and CCA were also included in the comics. In Aceh, materials that include religious messages will be much easily accepted. The materials need to also consider the audience's capacity to read and understand. Since fisherfolk and farmers are usually not in a habit of reading books, simple posters were produced for them. In the Philippines, an audiovisual production (AVP) was made, which presents some LINKs together with their scientific explanations. In addition to a poster for the general promotion of LINK, flipcharts were also developed to be used as a teaching aide in classroom teaching and in non-formal training settings.

Integrating local and indigenous knowledge with science and technology: Integrating all LINK identified and documented with a community with science and technology is difficult for reasons outlined above. Thus, in the Philippines and Indonesia, integration was done only for selected LINK. The LINKs that are based on traditional beliefs and religions that cannot be validated at this point in time by science were not usually promoted in IEC materials. However, such LINK can be included in other forms of awareness-raising and educational activities to increase community resilience as well as to preserve a community's social capital.

Figure 4 below shows an example from a comic book about a predictor of storms mentioned in *Keuneunong* (traditional calendar) found in Aceh. The figure shows the relevance of LINK with science and technology, and demonstrates why such LINK is a valid tool for DRR and CCA. Another example is the AVP developed in the Phillippines, which presents some LINK found in the area, followed by scientific explanations given by scientists. With this process, the audience can clearly understand the scientific explanations behind some LINKs.

Figure 4: An excerpt from the comic book titled *Mari Belajar Keuneunong* (Let's learn about Keuneunong). The figure shows that location of the beehive enables communities in Aceh to predict the coming sea-storm



Validating content: Before disseminating IEC materials, their content should be validated by communities and scientists to ensure accuracy. Pictures, messages, graphics, or conversations included in the materials need to be checked thoroughly to ensure that the materials meet their objectives. Validation should also ensure that the materials follow the principles of KIDA (Knowledge, Interest, Desire, and Action).

Evaluating the effectiveness of the materials: The effectiveness of the produced materials should be checked to see whether the initial objectives do indeed deliver impacts on the community to revitalize LINK and/or to strengthen the visibility of LINK for DRR and CCA. Evaluation can be done by putting important points to review the impacts, such as:

- does the audience correctly understand the advantages of practising LINK for DRR and CCA?
- can the audiences see the relevance of LINK from scientific and technological point of view?
- is the audience motivated to take actions to strengthen LINK in their community?

The IEC materials developed have to be incorporated into actions at the community- and government levels. It is important that materials incite actions, without which it is difficult for LINK to be widely used as a tool for DRR and CCA. Policy actions should aim to increase the capacity of CSI communities to cope with hydro-meteorological hazards and impacts of climate change. IEC materials that are targetted to become part of a country's educational curriculum will need to go through certain procedures to make them available and accessible to schools in the country.

As discussed above, the research conducted under the APN project resulted in a tool to integrate science with LINK, and IEC materials based on knowledge integrated. These are significant in that the tool and materials were jointly developed by scientists and communities, and they can be adapted for use by both scientists and non-scientists. They must work together to integrate LINK with scientific knowledge, and the participatory methods adapted for this research makes it possible for collaborative research to take place.

Two gaps can be identified in the research undertaken for the APN project. First, most of the action research was implemented in small communities with population of between 3,500-5,000. Similarly, most sites were described as being homogeneous (i.e., sharing the same religion and/or beliefs and ethnicity). If this tool for knowledge integration were to be used in larger, more diverse, and urban contexts, many adjustments would need to be made.

Second, it is necessary to avoid romanticization of LINK; it should not be seen as a panacea. It has been noted that romanticization of LINK, especially by non-governmental organizations and indigenous rights organizations, should be avoided, as it can reduce its reliability (CBD 2003; also Sillitoe 1998). Similarly, LINK, especially those that help increase community resilience, is dynamic. No knowledge is made in a vacuum and LINK, just like science, has interacted with external forces and incorporated non-local information and practices (including scientific knowledge) over time (Cruickshank 2005). Thus, the process of documenting and validating LINK is one that needs to be undertaken regularly; documentation of knowledge is not for safe-keeping, as this process can render LINK static (cf. Agrawal 1995). Such a process will also make it possible for the knowledge and practices to continually evolve according to changes in the environment and climate, which would be an important component for climate change adaptation.

4.0 Conclusions

From the research and results described above, it is clear that we have been able to meet the main objectives of the project, which were to:

- facilitate cooperation among scientists and non-scientists in Indonesia, Japan, the Philippines and Timor-Leste and thereby contribute to their scientific capacity-building to integrate scientific and local & indigenous knowledges;
- build the capacities of scientists and non-scientists to develop information, education and communication materials on disaster risk reduction and climate change adaptation that integrate scientific knowledge with local & indigenous knowledge; and
- build the resilience of communities living in coastal zones and small islands in Indonesia and the Philippines against hydro-meteorological hazards and climate change impacts.

The important aspect of the knowledge integration and IEC development process undertaken by the research described in this report is that it is participatory. For example, validating LINK by the community themselves means that there are local researchers trained to do it. LINK validation and integration of scientific knowledge must be done through participatory action research where local communities are trained on the research process and mentored to enable them to do the research by themselves. Thus, the challenge in adopting "LIVE Science Knowledge" as a validation and integration tool is the requirement to adapt participatory approaches. Individuals and institutions would have difficulty to use the tool if they are not familiar with and committed to participatory approaches, most notably action research perspectives and methods.

Thus, the process of integrating science with LINK, the following precautions need to be noted:

- The process of validating and scientifically explaining LINK, and integration of science with LINK, both require community engagement and open communication, and close linkages between communities and external scientists and researchers. The learning process is two-way and it is important for all stakeholders to acknowledge this.
- Inventory, validation and establishment of scientific basis of LINK are an endeavour that requires local and national mandate and they must be recognized as priorities.
- Scientists have a significant role to play in enhancing LINK with science.
- DRR and CCA programs, projects and strategies must integrated with LINK that have scientific bases.
- LINK that cannot be explained by science should not be disregarded but should be seen as part of the people's way of life that can help them adapt to climate change impact and reduce their vulnerability.

Based on the development of IEC materials that strengthen LINK for DRR and CCA, several findings were made:

- Development of IEC materials needs to carefully consider the context where the materials will be disseminated, the target audience, and the cultural (including religious) sensitivity of the process.
- IEC materials need to incite actions in communities to utilize LINK for DRR and CCA.
- The contents of the IEC materials should be inspiring and encouraging, and include the KIDA principles.
- To ensure the effectiveness of IEC materials, its dissemination and advocacy back into the CSI community is best done using a strategic plan.

5.0 Future Directions

In terms of further work on this topic, as mentioned above, this project was implemented in the second year of a 3-phase project that aims to build the resilience of communities living in coastal zones and small islands against hydro-meteorological hazards and climate change impacts in Indonesia, the Philippines, and Timor-Leste, called "Strengthening Resilience of Coastal and Small Island Communities towards Hydro-meteorological Hazards and Climate Change Impacts (StResCom)". Currently, the results of the APN project are being consolidated and taken one step further to implement the third phase of the StResCom project, during which: (1) IEC materials are being strategically disseminated; (2) the use of knowledge integration tools are being demonstrated; (3) a capacity-building programme for communities, civil society and government officials on the importance of local & indigenous knowledge for disaster risk reduction and climate change adaptation will be implemented. In this sense, the APN-funded project was an integral part of the larger project and substantially enriched the project outcomes and strengthened the expected results. It has played a crucial role in leading the Japanese-government funded StResCom project to its third year.

In addition, further work based on this research that could be implemented is to broaden the scope to a wider range of sites and countries, to use and adapt the tool developed to integrate local & indigenous knowledge with science. To adapt the tool to urban areas would be challenging yet worthwhile exercise. This would then lead to revisions of the tool (as necessary) and development of IEC materials in a larger number of sites, thus contributing to increased resilience of communities across the region.

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APPENDICES

Two Workshop Reports

IEC materials developed in Indonesia and the Philippines:
Indonesia:

- Comic books:
  - *Uteun Bangka Penjaga Pantai Kita*
  - *Bermain di Uteun Pasie*
  - *Belajar Keuneunong*
  - *Angeen Badee sang Perusak*
- Posters:
  - *Angeen Badee*
  - *Uteun Pasie*
  - *Uteun Bangka*
- Booklets:
  - *Pengetahuan Asli dan Lokal Angeen Badee*
  - *Pengetahuan Asli dan Lokal Keuneunong*
  - *Pengetahuan Asli dan Lokal Uteun Pasie dan Uteun Bangka*

Philippines:

- Poster: "Ang 7K"
- Video: "Ang Mga Katutubong Kaalaman ng Rapu-Rapu" (with English subtitles)
- Flipchart: 10-page flipchart in English

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- Graduate School of Global Environmental Studies, Kyoto University: funds for "write-shop"
- Lee Kuan Yew School of Public Policy, National University of Singapore: in-kind support.

List of Young Scientists

Many of the researchers involved with this project were young scientists, however, because project did not focus on young/early career scientists/researchers, none are mentioned in this section.

Acronyms

APN	Asia-Pacific Network for Global Change Research
CCA	Climate change adaptation
CBDRM	Community-based disaster risk management
CDP	Center for Disaster Preparedness, Philippines
CSI	Coastal and small islands
DRR	Disaster risk reduction
FGD	Focus group discussions
IEC	Information, education and communication
IPCC	Intergovernmental Panel on Climate Change
KIDA	Knowledge, Interest, Desire, and Action
LINK	Local and indigenous knowledge and practices
LINKS	Local and Indigenous Knowledge Systems Programme of UNESCO
LIVE Scientific Knowledge	Local and indigenous knowledge and practices Inventory, Validation, and Establishing Scientific Knowledge
MPBI	Indonesian Society for Disaster Management
NGO	Non-governmental organization
StResCom	Strengthening Resilience of Coastal and Small Island Communities towards Hydro-meteorological Hazards and Climate Change Impacts project of UNESCO Jakarta
TDMRC	Tsunami and Disaster Mitigation Research Center, Indonesia
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISDR	United Nations International Strategy for Disaster Reduction
UNTL-CNIC	National Center of Scientific Research, National University of Timor-Leste

Glossary of non-English terms

Angeen badee (Acehnese, Indonesia): Prediction of sea storms

Hydro-meteorological hazards: "Process or phenomenon of atmospheric, hydrological or oceanographic nature", and in the Southeast Asian context, includes tropical cyclones (typhoons and hurricanes), thunderstorms, coastal storm surges, floods (including flash floods), drought, heatwaves and cold spells. It is also important to note that such hydro-meteorological conditions can also be a factor in other hazards such as landslides and wildfires (UNISDR 2009).

Local and indigenous knowledge: Understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. For rural and indigenous peoples, such knowledge informs decision-making about fundamental aspects of day-to-day life (UNESCO undated).

Keuneunong (Acehnese, Indonesia): Traditional Acehnese calendar system used for estimating a good time for fishing to avoid sea-storms, and to start cultivation

Panglima Laot (Indonesian): A traditional fishermen's organization in Aceh, with a unique structure from provincial level up to a certain river mouth area.

Uteun bangka (Acehnese, Indonesia): Combination of several types of mangrove forest.

Uteun pasie (Acehnese, Indonesia): Coastal forest which consists of a number of vegetation found around a coastal area.