PROJECT "BUILDING CAPACITY FOR WEATHER FORECASTS AND WARNINGS TO IMPROVE EARLY WARNING OF EXTREME WEATHER AND RESILIENCE TO CLIMATE EXTREMES IN THE PHILIPPINES".

Work package 2: Assessment of current understanding of risks.

WORK PACKAGE REPORT

Prepared by: Clemencia Licona Manzur, project consultant

Date: 26 October 2015

CONTENT

ACRONYMS

ADB	Asian Development Bank
ADP	Asian Disaster Preparedness Center
AusAid	Australia Agency for International Development
BAS	Bureau of Agricultural Statistics
BSWM	Bureau of Soils and Water Management
CLUP	Comprehensive Land Use Plan
SCO	Civil Society Organisation
CSCAND	Collective Strengthening on Community Awareness on Natural Disasters Agencies
DA	Department of Agriculture
DFAT	Australian Department of Foreign Affairs and Trade (Formerly AusAid)
DENR	Department of Environment and Natural Resources
DepEd	Department of Education
DFID	Department for International Development
DILG	Department of Interior and Local Government
DOE	Department of Energy
DOH	Department of Health
DPWH	Department of Public Works and Highways
DRA	Disaster Risk Assessment
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
ENSO	El Niño Southern Oscillation
ESSC	Institute for Environmental Science for Social Change
FA	Flood Area
FFWS	Flood Forecasting and Warning System
GFDRR	Global Facility for Disaster Reduction and Recovery
GIS	Geographic Information System
GOP	Government of the Philippines
GPS	Global Positioning System
GIZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HFA	Hyogo Framework for Action
IEC	Information, Education and Communication
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
LGU	Local Government Unit
MGB	Mines and Geosciences Bureau
MMDA	Metro Manila Development Authority
NAMRIA	National Mapping and Resource Information Authority
NDCC	National Disaster Coordinating Council
NDRRMC	National Disaster Risk Reduction & Management Council
NEDA	National Economic and Development Authority
NGO	Non-government organization
NLUC	National Land Use Committee
NPC	National Power Corporation
NSCB	National Statistical Coordination Board
NSO	National Statistics Office
OCD	Office of Civil Defense
OML	Oscar Lopez Center for Climate Change Adaptation and Disaster Risk Management
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PCIC	Philippine Crop Insurance Corporation
PHIVOLCS	Philippine Institute of Volcanology and Seismology
RAP	Risk Analysis Project
READY	Hazards Mapping and Assessment for Effective Community-Based Disaster Risk Management Project

EXECUTIVE SUMMARY

INTRODUCTION

The project *Building capacity to improve resilience to weather and climate extremes in the Philippines* (Figure ES1) is collaboration between the United Kingdom Met Office and the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). It is funded by the United Kingdom Department for International Development (DFID)[a]. Work package 2 (WP2), *Assessment of current understanding of risks and risk mapping* is one of the sets of activities of this project.

Figure ES1. Schematic of the Project Building capacity to improve resilience to weather and climate extremes in the Philippines.

[a] For more information on these institutions see: PAGASA (http://www.pagasa.dost.gov.ph/), DFID (https://www.gov.uk/government/organisations/department-for-international-development) and Met Office (http://www.metoffice.gov.uk/).

Work package 2 aimed to review and assess current understanding of climate hazard and risk by different society groups in the Philippines; to determine the effectiveness of information being produced there; and to identify gaps and opportunities for the project to generate relevant and useful information products.

PROJECT DEFINITIONS

The definitions used throughout this work are those from the Intergovernmental Panel on Climate Change (IPCC, 2014):

- Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. In this report, the term hazard usually refers to climate-related physical events or trends, or their physical impacts.

- Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognising the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure and hazard.

- Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

- Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.

The climate hazards considered were: droughts (primary hazard), extreme high temperatures (primary hazard), flash floods (climate triggered hazard), hailstorms (primary hazard), extreme rainfall (primary hazard), high-speed winds (primary hazard), landslides (climate triggered hazard), sea level rise (primary hazard), storm surge (climate triggered hazard), thunderstorms (primary hazard), tornadoes (primary hazard), tropical depressions (primary hazard), tropical storms (primary hazard) and typhoons (primary hazard).

EXPECTED OUTCOMES

The work carried out by the project team was expected to contribute to several outcomes:

- Assessing the level of understanding of climate hazard and risk of different stakeholder categories, by identifying information available in the country and finding out how much

stakeholders knew about this information and how they used it

- Increasing coordination with different Philippine institutions and international and bilateral cooperation agencies working in the country, by approaching them and discussing past, current and future work and projects relating to climate hazard and risk
- Expanding the network of the Climate Impact Assessment Section and the Climate Data Management Section in PAGASA
- Raising the perception of stakeholders regarding the willingness of PAGASA to listen to their needs by engaging them in a dialogue
- Contributing towards organising the available information on studies and projects in the country by compiling information and creating a database of hazard and risk work
- Identifying groups of stakeholders that could be fundamental for the dissemination of climate risk/hazard information to support PAGASA in their efforts to deliver information at local level
- Creating a network of stakeholders who would be aware of the project and its products

METHODOLOGY

The work carried out for this work package consisted of a series of stages that allowed the project team to: 1) identify and engage stakeholders; 2) compile available information and identify major projects related to climate hazard and risk; 3) investigate the current understanding of climate and hazard risk of different categories of stakeholders; 4) identify information needs of specific stakeholder categories; and 5) discuss potential project products that could satisfy the needs of different information users. A summary of the stages is included in Figure ES2.

The project team looked for current and past activities that contributed to climate hazard and risk management in the Philippines from earlier stages of the overall project, with the purpose of avoiding duplication, using resources where more work was needed and producing products that were relevant for different categories of stakeholders.

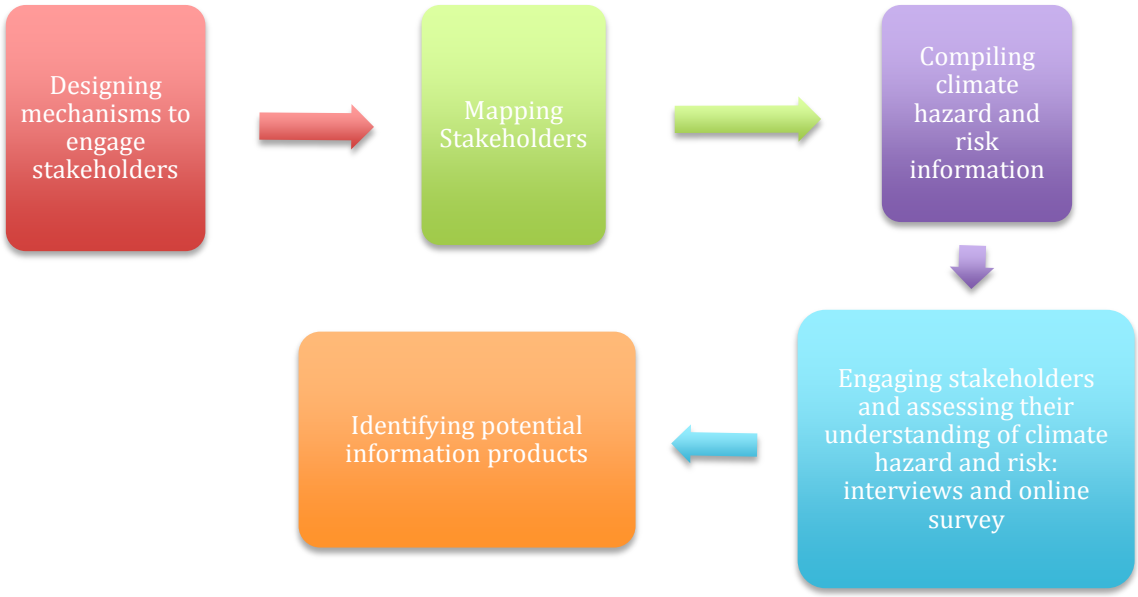

Figure ES2. Stages of work package 2.

FINDINGS

Designing mechanisms to engage stakeholders

The project team analysed ways in which stakeholders could be involved, for example, they explored the possibility of organising meetings, workshops, working groups or carrying out interviews and surveys. Given the time and resources available they chose to: 1) interview a few representatives from national agencies, the private sector and international agencies; 2) carry out an online survey; and 3) take the opportunity to discuss the project through meetings held by PAGASA or attended by the project team. A short paper (Annex I) delineated the approach and identified potential groups of stakeholders.

The project team also prepared a project brief to summarise the aims of the project and expected products, which was distributed during interviews and as an introduction to the online survey.

Mapping stakeholders

The project team identified stakeholders that were climate hazard or risk information producers, current users or potential users. Stakeholders across the different categories typically consulted in development projects were identified—these categories included the Government, Civil Society Organisations, Private Sector, Research, Academia and International or Bilateral Cooperation Agencies. All these categories tend to have representatives that either produce or use hazard or risk information.

The project team prepared an initial list of stakeholders by searching online for potential representatives of the different categories. This was complemented with a list of regular contacts

provided by PAGASA.

In addition to identifying potential stakeholders for each category, the initial screening helped to highlight the components and layers of the Philippine Government (See Figure ES3).

The project team identified 300 potential stakeholders (Section 7 and Annex II) across the different categories of stakeholders. For the government category, those chosen represented various levels belonging to the executive and legislative branches (the legislative branch was not considered until concrete projects could be presented) and seniority (ranging from ministerial to technical positions). The project team also attempted to identify representatives from different economic sectors in the Philippines, including, agriculture, banking, disaster risk management, energy production, food production, infrastructure management, natural resources management, and tourism (both government and private sector).

The process also helped to identify stakeholders that could be key for the success of the project, either because they were directly involved with making policies regarding disaster risk management or could actively disseminate information at different levels. Key stakeholders included:

- Policy making: Department of Interior and Local Government (working directly with local governments), the National Economic and Development Authority (drafting policies and carrying out relevant programmes) the National Disaster Risk Management and Reduction Council (direct users of information and in charge of prevention and response programmes), the Office of Civil Defense (working directly with local authorities), the Department of Science and Technology (PAGASA's mother organisation) and the Department of Budget and Management (assigning funds for potential follow up work). Other key agencies are included in Table 1, Section 7.

- Information producers: National agencies that have traditionally produced geohazard information (hazards related to natural events) were also identified. These included PAGASA, The Mines and Geosciences Bureau (MGB), the Philippines Institute of Volcanology and Seismology (PHIVOLCS). The private sector and research were also represented by institutions like the Manila Observatory, which has work on hazard assessment and the Oscar M. Lopez Center for Climate Change Adaptation and Disaster Risk Management Foundation, Inc. that is dedicated to disseminating information.

- The Asian Development Bank and bilateral cooperation agencies such as the Australian Department of Foreign Affairs and Trade and the German Cooperation Agency (Deutsche Gesellschaft für Technische Zusammenarbeit), were also identified as agencies regularly involved in Disaster Risk Management Work.

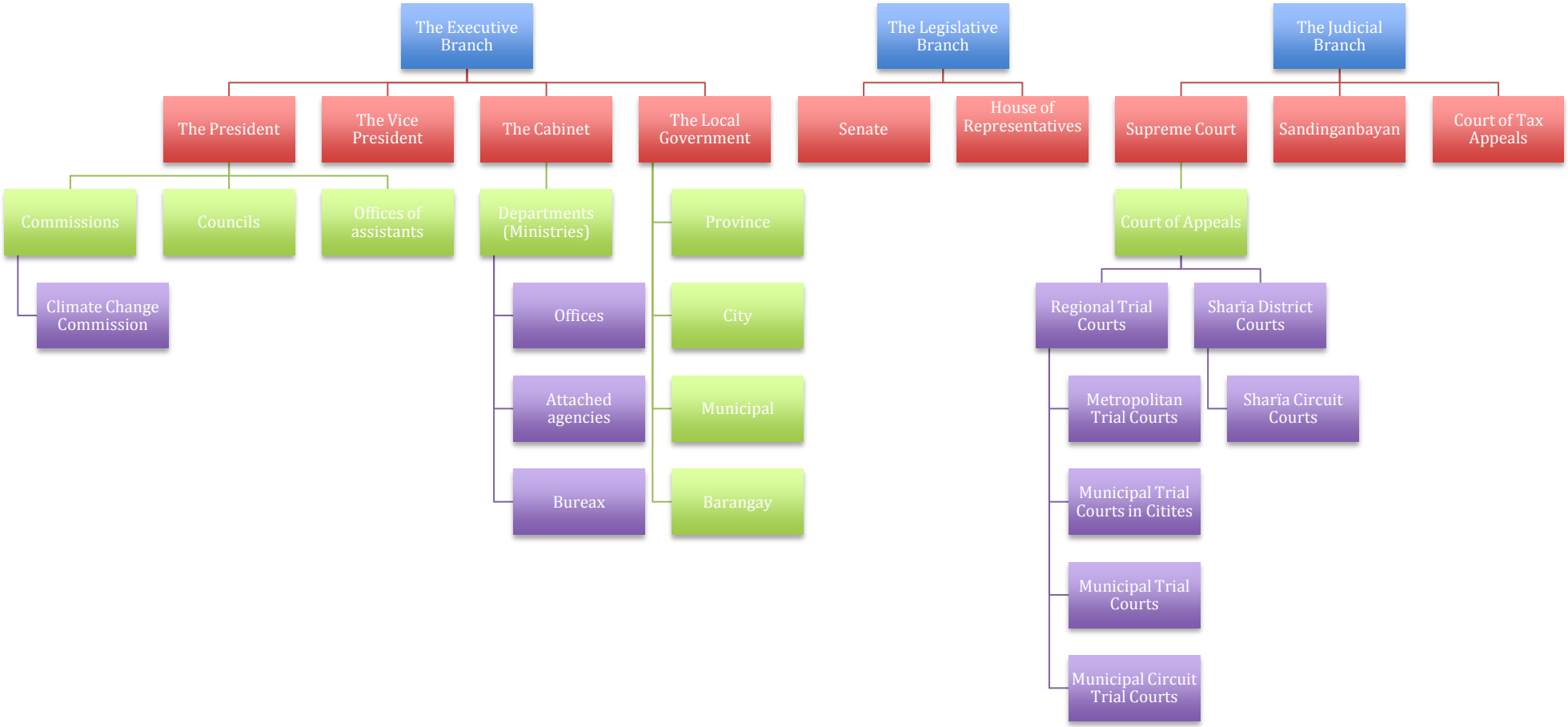

Figure ES3. Schematic of the Philippine Government hierarchy (assembled with information from The Official Gazette of the Government of The Philippines).

Compiling hazard and risk information

According to the Germanwatch Global Climate Risk 2015 Index, the Philippines is ranked as the 5th country most affected by extreme weather events between 1994 and 2013 (Kreft *et al.*, 2015). The Philippines is also prone to other geohazards (e.g. volcanic eruptions, earthquakes, ground subsidence, tsunamis), which has made it the subject of a significant amount of related work, both from national and international institutions.

The project team identified available climate hazard, vulnerability or risk information produced to date, including major projects that have been carried out by different institutions. The information found indicated that the work on geohazard assessment started in the 1960s, involving a few agencies, such as PAGASA, the Philippine Institute of Volcanology and Seismology, the Mines and Geoscience Bureau and the Manila Observatory. Newer programmes and projects have emerged in the last few years with some, unavoidably, producing duplication of information and conflicting methodologies and results. For example, PAGASA, the Programme Nationwide Operational Assessment of Hazards, the Mines and Geosciences Bureau and the Climate Change Commission are all working with flood hazard assessment.

Since 2000, at least 10 large projects mapping geohazards or risk were identified (Section 9.5). In recent years there has been a tendency for projects to bring together multiple agencies to produce multihazard maps (for example, climate hazards, earthquakes, volcanic eruptions), as is the case of the Hazards mapping and assessment for effective community based disaster risk management READY Project (Section 9.5.2) and the Enhancing Risk Analysis Capacities for Flood, Tropical Cyclone Severe Wind and Earthquake for Greater Metro Manila Area, RAP Project (Section 9.5.4). These projects bring together the Collective Strengthening on Community Awareness on Natural Disasters (CSCAND) Agencies, composed of the Mines and Geosciences Bureau (MGB), the Philippines Institute of Volcanology and Seismology (PHIVOLCS), PAGASA, and the National Mapping and Resource Information Authority (NAMRIA). Yet, it seems difficult to locate information in ways that are understandable to the general public.

From the literature it was also evident that the country had historical data on climate hazards (e.g. typhoons, extreme rain, droughts, flooding and landslides) and, in some instances, also on risk (involving vulnerability and exposure), but more information is needed on potential risks associated with climate change. For instance, on how climate hazards and risks could change under projected future climate scenarios and the impacts they could have on different geographic areas or economic sectors.

In addition to producing information, there is a need for a better strategy for making information available to different types of users, according to their specific requirements.

Engaging stakeholders and assessing their understanding of climate hazards and risks: interviews and online survey

The project team established a dialogue with different stakeholders through interviews and an online survey.

Interviews

The project team carried out 32 face-to-face interviews. All the interviews included a brief introduction to the project and a discussion of the role of the person/institution regarding climate hazard/risk work, the information they produced, how they used information and if they would find the project information useful. Interviewees were also invited to participate in the online survey or to distribute information on the survey to their colleagues. They were also left to expand on their current perception of information dissemination by PAGASA and how could they improve. Institutions approached to take part in interviews are listed in Table 3 and a summary of the interviews is included in Annex IV.

In general, interviewees welcomed the project and saw the potential to use its potential products. Most of them were producers of climate hazard or risk information or were involved with programmes that regularly used such information. Most of them were particularly interested in learning how climate change could influence the recurrence of hazards and associated risks in the future. Some pointed out that there is a need for having information products that are easy to understand, some others mentioned that there was a need to build the capacity of communities to understand and disseminate this information.

Online Survey

The project team prepared six questionnaires (one for each stakeholder category) and uploaded them to an online platform. They extended a personal invitation to the 276 stakeholders identified during the mapping of stakeholders.

Out of a total of 163 respondents, 108 replies were used in the data analysis, because some of the replies contained only contact data. The largest number of replies came from the National Government (60) and the Local Government Units (27), followed by the Private Sector (7), Civil Society Organisations (5), International Organisations (5) and Research and Academia (4).

The results from the survey revealed that knowledge of climate hazard and risk information varies among stakeholder categories, but in general, only 50% of the respondents seemed to be aware of climate and hazard risk information produced in the country, in the form of reports, maps or information campaigns.

It was also evident that even if they were aware of the information, many did not fully understand it or know how to use it. For example, some confused the terms hazard and risk and did not know the difference between historical data and projections.

The institutions that produced information were located mainly within the international organisations and national government categories. This might be because international organisations have dedicated programmes and often allocate funds and expertise to support the work of countries to reduce the impacts of climate hazards. National agencies may also have larger funds to attract experts to work on disaster risk management. Local Government Units, Civil Society Groups, the Private Sector and Research and Academia were mostly information users

(they may not have the resources or the mandate to produce information).

It is also worth noting that when respondents were asked to rank hazards, they ranked typhoons, tropical storms, heavy rain and landslides as the most important, but sea level rise was considered the second least important climate hazard (after hailstorms, which occur infrequently in the Philippines). That sea level rise is not currently considered as an important hazard is interesting, given that the Philippines is a country made of 7,107 islands and that projected impacts of one-metre sea level rise in many areas of the country show vast portions being inundated, affecting coastal settlements and livelihoods. According to estimates of the National Mapping and Resource Information Authority, a one-meter sea level rise translates to an estimated land loss of 129,114 ha (CCC, 2012).

In general, stakeholders who replied to the user need section of the survey highlighted that current climate hazard tools, e.g. the websites of PAGASA, the GEOPORTAL project (an initiative to compile maps in one single platform (Section 9.5.10), the Project Nationwide Operational Assessment of Hazards are difficult to use for non-technical users. They requested more information addressed to Local Government Units, communities and farmers.

Identifying potential information products

Given the existence of projects, institutions and methodologies for mapping hazards in the Philippines, resources were used, not to produce another hazard map (as originally planned), but to identify information products that the project, or PAGASA, could produce in order to better assist economic sectors, Local Government Units and communities in their work towards disaster risk management.

Trying to answer common questions that decision makers tend to ask, the project team identified a preliminary set of products related to climate hazards/risks and climate change that could be useful in the Philippines.

The questions addressed basic climate variables and their change over time, hazard and risk, spanning across the different climate change projections (e.g. temperature changes, precipitation changes, sea level rise) and hazards (e.g. tropical storms, typhoons, flooding, storm surge).

Below are some of the examples of questions used to identify potential information products:

- Basic:
    - For a given emission scenario, for a given period (e.g. 5–10 year periods), how does temperature change by month, every 3 months, every 6 months?
    - What is the average sea surface temperature by 2020, 2040, 2050?
    - For specific time periods, are there more frequent heavy rainfall events? Does frequency of heavy rain change for these periods? How?
    - For a given period of time and a given season, how does humidity change

compared to Normals?

- Basic Tropical cyclones (without impact)
    - How has the intensity of typhoons changed in the last 30, 60 years? Which are the areas most hit?
    - What is the probability that an event like Haiyan/Yolanda or larger happens in the next 10, 20, 30, etc. years? Where is this most likely to happen?
    - What are the most likely tracks and do they behave as they do currently? Do they look different under El Niño and La Niña conditions?
    - How could changes in intensity/frequency of typhoons change storm surge height?
    - How often are floods expected as a result of typhoons? Where?
- Tropical cyclones hazards
    - What is the probability of typhoons of category 4, 5/super typhoon hitting highly urbanised cities within the next 25 and 50 years?
    - For a given period, how many times could a particular province be hit by a category 4 typhoon or above?
    - Which would be the areas most likely to be flooded? Or which areas would experience most recurrent inundation?
- Tropical cyclones risks
    - Which were the areas most hit by typhoons in the last 30 years? What is the distribution of costs of the impacts?
    - Would roads and bridges need to be built in a different way? What would be the impact of change in frequency/intensity of tropical cyclones on roads?
    - What would be the impacts of changes in frequency/intensity of tropical storms on major cereal and cash crops for selected provinces? What would be the cost of not taking action?
    - High speed winds: how frequent and how strong could they become and what would be the costs of damage to urban areas, rural areas and coastal and upland communities?

The questions above are just a few examples of common questions asked by decision makers. A wider set of questions were asked to guide the design of information products produced by this project. It will take some time and effort and perhaps more than a single project to answer few of

these questions..

More details on these questions and the potential usefulness of related products for a few sectors have been included in Annex VI. The project team expects to continue refining these products during pilot trials by consulting stakeholders from different economic sectors.

GAPS AND OPORTUNITIES

Gathering the findings from different stages, a number of gaps and opportunities were identified. These include:

- While there are hazard/risk mapping efforts in the country, there is often a shortage of personnel to produce, analyse and transfer this information at all levels, but in particular, in the Local Government Units. There is an opportunity to identify mechanisms to improve the availability of personnel for these tasks. Also providing incentives for young people to become local meteorologists through, for example, climate field schools.

- Information dissemination and outreach are a problem, given the lack of personnel and the lack of understanding of the needs of users. Until now, scientists and highly technical staff have been in charge of disseminating information. These often result in information that is not easily understood by non-specialists. There is an opportunity to create a culture of “user needs satisfaction” and train younger generations to write and deliver messages in a way that is better understood by the general public. Making stronger partnerships with the media and private sector may be part of a larger dissemination strategy.

- It is often difficult for the general public to understand the magnitude of hazards. These could be improved if technical officers acquire better communication skills and ways to make sure that people picture the potential consequences of an upcoming climate event.

- Agencies like PAGASA or the Mines and Geosciences Bureau do not have enough capacity to reach the 42,000 Barangays in the country directly, therefore more creative mechanisms need to be devised, perhaps using mobile phone alerts or social networks. The Philippine Atmospheric, Geophysical and Astronomical Services (PAGASA), for example, has a Facebook page, but pages for specific municipalities could be created, if local meteorologists were available to maintain them. Also, PAGASA has an initiative working with farmers, called “climate field schools” that could be further used as a mechanism for hazard and risk information dissemination.

- There is a need for more specific data for different economic sectors, but there is also the need to involve these sectors in the generation and analysis of climate hazards information and their impacts. It should not be the sole responsibility of PAGASA to generate this information. Mechanisms for involving both government agencies and the private sector within the different economic sectors should be found.

- Data sharing has traditionally been a problem. It has improved recently among the Collective Strengthening on Community Awareness on Natural Disasters (CSCAND)

Agencies, but hazard information needs to be made available and free for those who can make good use of it.

- The results of interviews and the survey highlighted that there is also an urgent need to empower Local Government Units to produce and manage their own information, in order to reflect local conditions and help them plan better to reduce the impacts of climate and other natural hazards.

- Some survey respondents indicated that national hazard maps often do not correspond to local conditions. There are opportunities to work directly with communities to map hazards more accurately and especially to train communities to update these maps. An important issue is that maps are good but they are static data, unless they can be updated regularly—communities are in a better position to do that. The problem is often the lack of capacity of Local Government Units, who do not have personnel that can map or understand mapping.

RECOMMENDATIONS

As part of a wider strategy to work towards more effective hazard information management (in the context of the project and beyond), the project team proposes the following:

- Building capacity to “translate” existing information at different levels, including national, subnational and among different stakeholder categories. For example, choosing a set of people who could be trained to deliver messages and train others to do the same.

- Complementing established initiatives, not embarking on new methodologies or mapping efforts. It is better to upscale what has been done already.

- Making the data from this project available to the general public.

- Using existing platforms for community outreach, e.g. climate field schools (PAGASA) or local mapping initiatives (for example, see Section 7.5.7).

- Given their role in policymaking and their capacity to reach local governments, keeping The Department of the Interior and Local Government and The Office of Civil Defense engaged in the project.

- Working with a few Local Government Units to pilot information dissemination for specific audiences, e.g. selecting two or three pilot sites and a variety of economic sectors and community groups to work with.

- Choosing pilot sites in areas less covered by international projects, e.g. outside Leyte (Tacloban).

- Approaching other key stakeholders, such as the National Economic and Development Authority and the National Disaster Risk Reduction and Management Council, once the products are delineated, to widen the project outreach and the potential for its products to

be used nationwide.

- If mapping hazard/risk: It is better to build capacity for mapping, not to prepare maps; apply a climate change dimension to current methodologies (to those where it has not been considered); and choose other highly urbanised areas.

- Carrying out a sector oriented analysis only if requested, as agencies seem to prefer doing their own work, and in partnership with the different sectors concerned. The project could, instead, contributing to further delineate which products could be useful for different economic sectors by engaging their representatives through pilot work.

More details are presented in the following sections and the annexes included at the end of this report.

1 INTRODUCTION TO THE PROJECT

Typhoon Haiyan, or Yolanda as it is known in the Philippines, affected more than 13 million people when it made landfall in the country in 2013. In response, the UK government provided financial assistance for reconstruction and resilience-building initiatives, including technical cooperation.

At the request of the UK Department for International Development (DFID) the Met Office has embarked on technical cooperation with the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) through the project "Building capacity to improve resilience to weather and climate extremes in the Philippines''. The project, which started in 2015 (and will last until 2016), has a series of objectives, including:

- Informing reconstruction plans—generating information from climate models relevant to the programmes being coordinated at country level;
- Liaising with key stakeholders such as national and local government as well as other groups working with communities;
- Building long term capacity for weather forecasting and disaster resilience in order to generate and analyse weather and climate information, and translate that into hazard warnings for contingency planners and the government;
- Promoting secondments and workshops involving staff from PAGASA and the Met Office;
- Applying novel science to provide information on climate risks, specifically in relation to typhoons.

The project has two major components—building capacity and building resilience. Each of the components was initially subdivided into the following work packages (WP) (Figure 1):

Building capacity

WP1. Situational assessment and training needs assessment of end to end forecast to warning systems including the National Monitoring System and through to civil response community.

WP2. Training to build in-country capacity for early warning including Met Office Unified.

WP3. Model workshops for PAGASA scientists and end-to-end severe weather events, effective planning training for PAGASA and wider civil response community.

WP4. Scientist secondments or scholarships to support sustainable knowledge exchange.

Building resilience.

WP1. Synthesis of available climate information to support short-term rebuilding

decisions.

WP2. Assessment of current understanding of risks and risk mapping.

WP3. High-resolution regional climate scenarios driven by future scenarios.

WP4. Planning for future climate related risks.

.

Figure 1. Schematic of the project *Building capacity to improve resilience to weather and climate extremes in the Philippines*.

2 AIMS OF THE WORK

Work package 2 (WP2), *Assessment of current understanding of risks and risk mapping* (building resilience component) evolved as the work progressed. Initially it aimed to reveal the current understanding of hazard and risk in the Philippines and to produce hazard/vulnerability/risk maps (based on historical data). Given the variety of mapping efforts already present in the country, the emphasis of WP2 shifted to:

- assessing the understanding of hazard and risk by different stakeholder groups;
- determining the effectiveness of information being produced; and
- identifying gaps and opportunities for this project to generate relevant and useful

information products.

3 DEFINITIONS

The project team used the following definitions from the Intergovernmental Panel on Climate Change (IPCC, 2014):

- Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. In this report, the term hazard refers to climate-related physical events or trends or their physical impacts.

- Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognising the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure and hazard.

- Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

- Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.

The climate hazards considered were: droughts (primary hazard), extreme high temperatures (primary hazard), flash floods (climate triggered hazard), hailstorms (primary hazard), extreme rainfall (primary hazard), high-speed winds (primary hazard), landslides (climate triggered hazard), sea level rise (primary hazard), storm surge (climate triggered hazard), thunderstorms (primary hazard), tornadoes (primary hazard), tropical depressions (primary hazard), tropical storms (primary hazard) and typhoons (primary hazard).

4 PROJECT STAGES

This report covers the different stages of this work package:

1. Identifying mechanisms to engage stakeholders: selecting mechanisms that would maximise the contact with stakeholders and get information from them.

2. Mapping stakeholders: Identifying different groups of society (stakeholder categories) who

either produce information or would benefit from climate hazard and risk information.

3. Compiling and cataloguing available information: including studies, maps and tools specific to hazard, vulnerability and risk being produced by different institutions working in the Philippines.

4. Engaging stakeholders while investigating the current understanding of climate hazards and risks and identifying user needs: This was the process for starting a dialogue with different stakeholders in order to ensure the project products are used beyond its duration.

5. Proposing potential project products and their potential usability based on the results of the online survey, interviews, findings and discussions with PAGASA and other institutions.

The main part of the document reports the key points of each stage, including an introduction to its purpose, the methodology, findings and recommendations (which include identifying gaps, opportunities and lessons learnt). More detailed information is presented in Annexes. Figure 2 shows a general scheme of the work carried out.

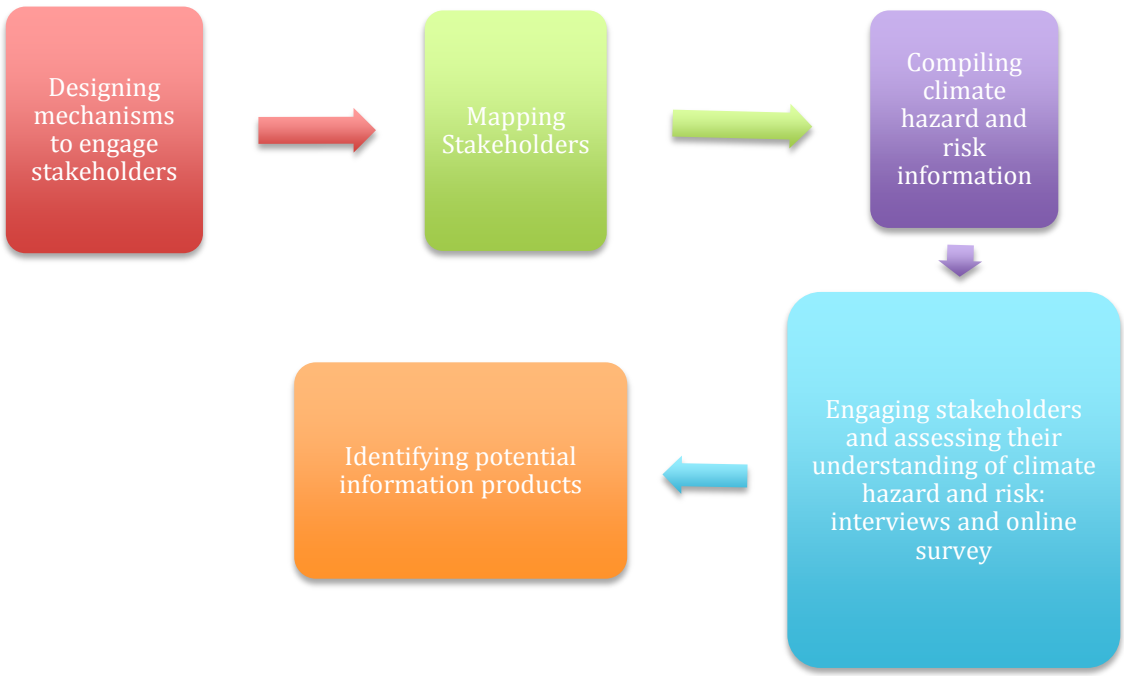

Figure 2. Stages of work package 2.

5 General approach

The work carried out for this work package consisted of a series of stages that allowed the project

team to: 1) identify and engage stakeholders; 2) compile available information and identify major projects related to climate hazard and risk; 3) investigate the current understanding of climate and hazard risk of different categories of stakeholders; 4) identify information needs of specific stakeholder categories; and 5) discuss potential project products that could satisfy the needs of different information users. A summary of the stages is included in Figure ES2.

The project team looked for current and past activities that contributed to climate hazard and risk management in the Philippines from earlier stages of the overall project, with the purpose of avoiding duplication, using resources where more work was needed and producing products that were relevant for different categories of stakeholders.

Met Office and DFID engaged an external consultant to work on the tasks for WP2. The consultant worked on the project from March to August 2015, in close collaboration with staff from the Met Office and PAGASA. The consultant visited the Met Office at the beginning of the assignment to meet with the Science and Business team. She then moved to the Philippines where she remained from 20 April to 12 June 2015, with the purpose of working alongside PAGASA, identifying and engaging stakeholders. Given that the work was done in collaboration with several staff of the Met Office and PAGASA, this report refers to the project team, regardless of who carried out the activities.

6 PREPARING A PLAN FOR INVOLVING STAKEHOLDERS

6.1 PURPOSE OF THE ACTIVITY

In order to agree to a methodology for involving stakeholders the project team prepared a short paper. The paper delineated the broad types of stakeholders that could be involved and how could they be approached (Annex I).

6.2 METHODOLOGY

The project team:

- searched for stakeholders across different sectors of the Philippines society, identifying major representatives for the common categories of stakeholders consulted in development projects, i.e. government at different levels, civil society, private sector, research and academia and international or cooperation agencies;
- analysed ways in which stakeholders could be involved (for example workshops, working groups, meetings, surveys and interviews); and
- chose a set of actions to further engage stakeholders.

6.3 FINDINGS AND RECOMMENDATIONS

As part of the initial identification of stakeholders the project team found that the proposed stakeholder categories consulted in development products were well represented in the Philippines.

A review of the government showed that the Philippines government operates at different levels. The Executive Branch has different components, including the Presidential Office, the Vice President Office, the National Departments and Local Government Units (LGUs). Local Government Units are present at regional, provincial, municipal and barangay, or village/district, levels (Figure 3).

Given the time and resources available they chose to: 1) interview a few representatives from national agencies, the private sector and international agencies; 2) carry out an online survey; and 3) take the opportunity to discuss the project through meetings held by PAGASA or attended by the project team. A short paper (Annex I) delineated the approach and identified potential groups of stakeholders.

The project team proposed to focus on consulting Local Government Units (provincial, city and barangay government units). The approach also included national agencies, the private sector, academia, research, civil society groups and international agencies operating in the country. The approach was refined after a discussion with a representative from the Department of Interior and Local Government (department mandated, in general to supervise local government units)[b], who suggested, that for the Local Government Units category, the project should concentrate on the provincial offices, given the short time available, as they would be in a better position to reply to the survey.

[b] Department of the Interior and Local Government, http://www.dilg.gov.ph/page/Powers-Functions/21.

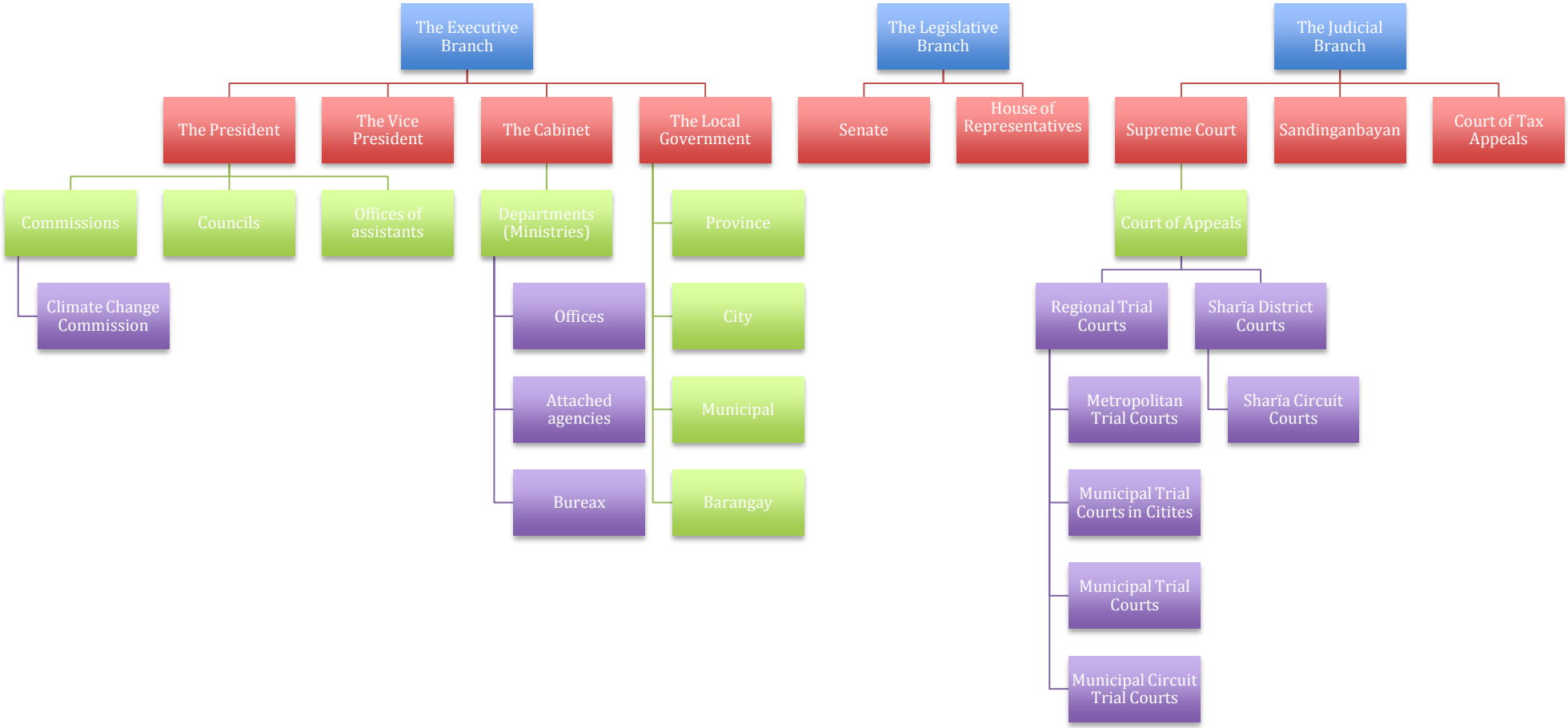

Figure 3. Schematic of the Philippine Government hierarchy (assembled with information from The Official Gazette of the Government of the Philippines).

7 MAPPING STAKEHOLDERS

7.1 PURPOSE OF THE ACTIVITY

Mapping stakeholders at the beginning of the project was considered important for three reasons: 1) identifying those groups that could benefit from the project products; 2) investigating the current understanding of climate hazard and risk of a selected group of stakeholders; and 3) identifying the information needs of different stakeholders in order to tailor the project products to specific audiences or uses.

7.2 METHODOLOGY

In order to identify the groups that might be interested in the project and its products, the consultant prepared a “stakeholder map”, a graphic representation of the different stakeholder groups and the potential institutions that might be involved with climate hazard or risk information usage. The stakeholder map showed the hierarchy of institutions for the government group, i.e., the composition of the different departments and their attached agencies or *bureaux*. The map included a common range of stakeholders consulted in development projects, including government, private sector, research and academia, civil society organisations, media and foreign institutions operating in the Philippines.

Using the Internet to research the country situation, the consultant prepared the stakeholder map in FreeMind, a mind mapping software that is useful to visualise ideas. Given the limited capabilities of the software to show the maps in other applications, the map was transported to a Microsoft Excel file.

The criteria for considering an institution as a stakeholder required that:

- it was key for the implementation of the project and its impact, or
- it produced hazard/risk information, or
- it was a current climate hazard/risk information user, or
- it could become a climate hazard/risk information user, or
- it could play a key role in the dissemination of climate hazard/risk information.

Stakeholders also had to represent the following economic sectors:

- Production (agriculture and food production)
- Infrastructure (housing, roads, energy production)

- Services (health, tourism, communications, education)
- Natural resources management (forestry, land and water management, conservation)

Stakeholders were differentiated into three groups:

Group 1: Those that were key for implementation and post project impact.

Group 2: Those who were information producers.

Group 3: Those who could be information users and information communicators (including those working on planning, disaster risk reduction and adaptation to climate change).

The Excel file with the stakeholder “map” classified stakeholders into different categories, the type of group where they belonged, provided the reason for their inclusion and identified a contact person. This file was presented to PAGASA so they could validate it and complement with their day-to-day contacts or provide more relevant contacts than those initially identified.

In addition, PAGASA invited the project team to several meetings, where the consultant presented the project and requested the audience to provide their details if they were interested in participating in the project survey.

Finally, additional stakeholders at national and local level were obtained indirectly through the assistance of the Department of Interior and Local Government (DILG), who extended an invitation to LGUs to participate in the survey. New contacts that neither the project team nor PAGASA held were obtained as a result of their participation in the survey. The Oscar M. Lopez Centre for Disaster Risk Management (private sector), the Deutsche Gesellschaft für Technische Zusammenarbeit (GIZ) and the Australian Department of Foreign Aid and Trade (DFAT) also provided contacts.

Figure 4 summarises the stakeholders groups and expands on the government and foreign institutions’ first levels

Figure 4. View of a section of the stakeholder map.

7.3 RESULTS AND RECOMMENDATIONS

In total, a list of 228 stakeholders was used as the starting point. The list was expanded with PAGASA's contacts to 300 stakeholders.

The different categories of stakeholders are described below, specific institutions and agencies are included in Annex II.

National Government stakeholders

The Philippines is the 13th most populated country in the world, with an estimated 99 million people (GOP, 2015a). The country consists of 7,107 islands grouped in three main clusters: Luzon, Visayas and Mindanao. The Philippines has an area of more than 300,000 square kilometres.

The government consists of the Executive, Judiciary and Legislative branches. The President, the Vice-president, the Cabinet and the Local Government are part of the Executive branch (GOP, 2015b).

In addition to the Executive Secretary, the cabinet is formed by the secretaries of the following Departments and Authorities: Agrarian Reform (DAR), Agriculture (DA), Budget and Management (DBM), Education (DepED), Energy (DOE), Environment and Natural Resources (DENR), Finance (DOF), Foreign Affairs (DFA), Health (DOH), Justice (DOJ), Labor and Employment (DOLE), National Defense (DND), Public Works and Highways (DPWH), Science and Technology (DOST), Social Welfare and Development (DSWD), Interior and Local Government (DILG), Trade and Industry (DTI), Transportation and Communications (DOTC), Tourism (DOT) Commission on

Higher Education (CHED) and National Economic and Development Authority (NEDA).

The Government Departments also have a number of *bureaux* and attached agencies and some have also regional offices. The list of Government Departments and their bureaux and attached agencies is included in the stakeholder list (Annex II).

The recurrence of natural disasters has prompted the creation of different councils and committees that coordinate response and preparedness efforts, disseminate information or attempt to incorporate disaster risk management in national and local planning. Among these institutions are the National Disaster Risk Reduction and Management Council (NDRRMC), the Office of Civil Defense, the Presidential Assistance for Rehabilitation and Recovery (OPARR) and the Climate Change Commission (CCC). These have taken a more prominent role especially after typhoons Ketsana (Ondoy), Parma (Pepeng) and Haiyan (Yolanda).

The responsibility for information generation regarding climate hazard/risks and climate change information lies in different departments and agencies, some of which have been producing information for several decades, for example, the Mines and Geosciences Bureau of the Department of Environment and Natural Resources (MGB, DENR) and the Philippines Atmospheric Geophysical and Astronomic Services Administration (PAGASA, DOST).

The agencies that are currently mandated to produce information on geo-hazards are the Collective Strengthening on Community Awareness on Natural Disasters (CSCAND) Agencies. These include: PAGASA, MGB, the Philippine Institute of Volcanology and Seismology (PHIVOLCS, DOST) and the National Mapping and Resource Information Authority (NAMRIA). However, two institutions or projects may have the mandate to produce similar information (which they do through different methods), which often results in discrepancies in specific areas and creates conflicts for end users.

The Government of the Philippines is complex and stakeholders at national level vary in their knowledge and involvement with climate hazard/risk information (see section 7.3.3). In total, the project team identified 54 institutions operating at national level that could be interested or benefit from the project information. They covered the different economic sectors and levels of policy making, varying from administrative ministries to more technical agencies. From these national institutions, 10 can be classified within group 1, or those that are key for the implementation of the project or post project impact (Table 1); 15 in group 2, or information producers; and 36 in group 3, or information users. Some can be classified within more than 1 group (see also Annex II).

Table 1. Government institutions (in addition to PAGASA) that are key for the implementation of the project or post project impact (Group 1). See also Annex I.

Institution	Reason to be key for project implementation and post project impact
Department of Budget and Management	They could be fundamental in releasing funding for regularly updating PAGASA's tools.
Department of the Interior and Local Government	Fundamental for the success of the survey and take up of project products. They are in a better position to get/provide information from/to local authorities.
Bureau of Local Government Finance, Department of Finance.	Potentially good for uptake of project products in Local Government Units.
Technical Cooperation Council of the Philippines, Department of Foreign Affairs	Potential project leverage and post project impact, by disseminating project results.
National Disaster Risk Reduction and Management Council, Department of Defense	Main council dealing with reconstruction, fundamental for project impact.
Department of Environment and Natural Resources (DENR)	DENR Bureaux have worked on geohazard identification for several years. Important partners with whom to coordinate to avoid duplication.
The Presidential Assistant for Rehabilitation and Recovery (OPARR)[c]	Fundamental for project leverage and post project impact. OPARR has the mandate to put coordinate rehabilitation efforts.
National Economic and Development Authority (NEDA)	NEDA has lead responsibility for Thematic Area 4: Rehabilitation and Recovery under the National Disaster Risk Reduction and Management Plan (NDRRMP, 2011–2028).
Climate Change Commission	Commission in charge of climate change adaptation, could be fundamental for post project impact. They are also producing hazard/risk information and have produced flooding scenarios considering climate change. Important for coordinating and avoiding duplication.
Department of Science and Technology	They are the department to which PAGASA is attached. They have also launched the Nationwide Operation Assessment of Hazards (NOAH) Programme. The project should make sure that it complements both PAGASA and NOAH's efforts.

Local Government Units stakeholders

The local government is further subdivided into 4 levels, Provinces (81), Cities (144), Municipalities (1,490) and Barangays (42,020), with different administrative responsibilities. Several Provinces

[c] At the time that work package 2 was carried out, OPARR was being reorganised and therefore it was not possible to contact them directly.

form a Region (18 Regions in total), but Regions, apart from the Autonomous Region in Muslim Mindanao, do not have administrative functions. The distribution of the different levels according to the National Statistical Coordination Board is shown in Table 2.

Table 2. Number of Provinces, Cities, Municipalities and Barangays by Region, as of July 2015.

Region	Provinces	Cities	Municipalities	Barangays
NIR – Negros Island Region	2	19	38	1,219
NCR- National Capital Region	0	16	1	1,706
CAR – Cordillera Administrativa Region	6	2	75	1,176
Region I – Ilocos Region	4	9	116	3,265
Region II – Cagayan Valley	5	4	89	2,311
Region III – Central Luzon	7	14	116	3,102
Region IV-A Calabarzon	5	18	124	4,011
Region IV-B - MIMAROPA	5	2	71	1,459
Region V – Bicol Region	6	7	107	3,471
Region VI – Western Visayas	5	3	98	3,389
Region VII – Central Visayas	3	10	97	2,446
Region VIII – Eastern Visayas	6	7	136	4,390
Region IX – Zamboanga Peninsula	3	5	67	1,904
Region X – Northern Mindanao	5	9	84	2,022
Region XI – Davao Region	5	6	43	1,162
Region XII - Soccsksargen	4	5	45	1,195
Region XIII - Caraga	5	6	67	1,311
ARMM – Autonomous Region in Muslim Mindanao	5	2	116	2,490
TOTAL	81	144	1,490	42,029

Source: National Statistical Coordination Board (http://www.nscb.gov.ph/activestats/psgc/listreg.asp).

The large number of Provinces, Cities, Municipalities and Barangays makes the effort of information dissemination, in whichever field, challenging, especially since the capacity of offices at different levels—and their access to information technology—vary greatly.

The Municipal and Barangay Local Government Units, being at the forefront of community life should be the ultimate target of information dissemination efforts. Unfortunately, Barangay and Municipal levels are those who have least access to the Internet.

Given the short time assigned to this work package and the fact that contact would be made through email and Internet, the project team had to choose a more manageable sample of LGUs. The criteria for selection were as follows:

- The project team assumed that climate risks are highest in areas where population density is highest, therefore, provinces were ranked according to their population density and the top 15 provinces were selected.

- From the remaining provinces 10 were selected at random.
- In addition, 11 highly urbanised cities were selected at random.
- Two independent cities were selected at random.
- Initially, each of the contacted offices was going to be asked to select 2 municipalities and 2 barangays to contact, but the DILG advised that this would take a long time and that they could contact their offices directly.
- The DILG also advised working with provincial offices, as they were the ones most likely to have the capacity to participate in the survey.

Research and Academia stakeholders

Stakeholders from the research and academia group also contribute to generating and disseminating climate hazard/risk information. For this category the consultant identified 10 institutions that could fall within groups 2 and 3. They included major national and international research centres and universities, which were carrying out research related to climate hazard and risk (See Annex II).

Civil Society Organisations stakeholders

Civil society organisations (CSOs) can be fundamental in information dissemination, especially in countries with challenging information distribution channels. According to the Asian Development Bank (ADB, 2013) the Philippines has a good network of CSOs that are active in the environmental field. These can vary largely in size and scope, therefore only the largest ones, with potential for cascading information, were selected. The consultant identified 10 major CSOs (see Annex II).

Private Sector stakeholders

The private sector, which has not been traditionally involved in the provision of climate hazard/risk information, can be an active partner in disaster risk management, especially since they can gain from working with communities when it comes to preventing and reducing the impact of natural disasters. Incentives can also be used to involve them in disaster risk management. The consultant identified 7 major companies that cover the different production sectors in the Philippines (food, beverage, banking, pharmaceutical, energy provision and manufacturing, insurance, retail). In addition, the Oscar M. Lopez Center for Climate Change Adaptation and Disaster Risk Management Foundation, Inc., a regular PAGASA partner, provided assistance in disseminating information to their contacts list.

International Organisations stakeholders

Most international organisations have a representation in the Philippines and many are contributing to disaster risk management. The project team choose those for whom there were contacts available either from the Internet or through PAGASA.

Recommendations

The initial mapping of stakeholders was meant to identify potential users of the project products. Preparing an initial list from an online search was a good start to facilitate the selection of stakeholders, but it was also important to involve PAGASA and the Department of the Interior and Local Government in the identification of stakeholders. This ensured that institutions that regularly work with project partners would be invited to learn from the project.

Combining the foreign perception of stakeholders with that of the national partners can be more effective, providing a wider coverage of stakeholders, as often country officers may not see the relevance of involving sectors or institutions if they do not traditionally work with them. At the same time, the country partners have a better overview of the political/institutional context and how institutions work, as well as which are the best channels to obtain results.

It is also important to involve key stakeholders—apart from the project partners—in the selection of stakeholders. In this case, the Department of the Interior and Local Government and the Oscar M. Lopez Center involvement greatly contributed to reaching out to a larger number of stakeholders.

Involving stakeholders should not be considered as a one-time activity. Project staff should inform them regularly on project progress. If stakeholders are responsive to project activities they are likely to be interested in benefiting from the results and may also want to see that the time they have invested is rewarded. Maintaining regular contact with stakeholders is a way to ensure that project products can survive beyond the duration of a project. It is recommended that PAGASA, the national partner and the institution that will establish a longer-term dialogue with stakeholders, keeps regular email contact with the selected project stakeholders through a mailing list, informing them of the progress of the project and requesting them to test the different information products.

8 ENGAGING STAKEHOLDERS AND ASSESSING THEIR UNDERSTANDING OF CLIMATE HAZARD AND RISK: INTERVIEWS AND ONLINE SURVEY

8.1 PURPOSE OF THE ACTIVITY

This was a process, rather than a single activity, that aimed to identify the different types of users and their level of knowledge regarding climate hazard or risk, as well as their information needs.

8.2 METHODOLOGY

The process consisted of several activities including preparing and distributing a project brief, interviewing selected stakeholders, designing and running an online survey, contacting stakeholders by email and following up with those who were participating in the online survey.

8.2.1 Project brief

In any project involving different types of stakeholders it is useful to have a written summary of the project. This should inform them on the project aims, its products and the benefits that it can bring to them.

The project team prepared a two-page project brief (Annex III), which was reviewed by DFID and PAGASA. This was distributed to stakeholders who were interviewed or to those who were invited to participate in the survey.

8.2.2 Interviews

The consultant and staff of PAGASA selected the stakeholders that could be interviewed. They agreed that the interviews would be phased, starting with a small group and expanding later on as the project products were better delineated.

The interviews were undertaken in the order of availability of interviewees. They took the form of semi-structured face-to-face interviews. This meant using established themes with flexible questions to adapt to the type of stakeholder—the project team interviewed stakeholders belonging to different groups and at different levels of seniority.

The interviews took place between 25 March and 10 June 2015 (Annex IV). The project consultant and PAGASA staff attended most of the interviews. The consultant also carried out some interviews by herself because PAGASA staff did not have time to attend.

All the interviews included a brief introduction to the project (with or without the project brief) and a discussion of the role of the person/institution regarding climate hazard/risk work, the information they produced, how they used information and if they would find the project information useful. Interviewees were also invited to participate in the online survey or to distribute information on the survey to their colleagues. They were also left to expand on their current perception of information dissemination by PAGASA and how could they improve. Institutions approached to take part in interviews are listed in Table 3.

Table 3. Institutions approached through interviews.

Type of stakeholder	Institution
National government agencies	PAGASA, The Climate Change Commission (Information technology officer); The Senate of the Philippines; the Environment and Safeguards Division, Planning Service, Department of Public Works and Highways; The Office of Civil Defense, Disaster Risk Reduction Council and National Economic and Development Authority; The Bureau of Soil and Water Management; the Philippine Crop Insurance Corporation; The Department of Interior and Local Government; the Department of Environment and Natural Resources.
Regional offices	Department of Environment and Natural Resources, Region 13, Conservation and Development Division; Department of Environment and Natural Resources, Sub-office Department of Environment and Natural Resources, Region 2; the Department of Environment and Natural Resources, Region 2.
International or bilateral agencies	The Asian Development Bank; The World Food Programme; The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ); the Australian Department of Foreign Affairs and Trade (DFAT); Geoscience Australia; the British Foreign and Commonwealth Office. In addition, the World Bank and USAid, Philippines were contacted by email.
Civil society	Institute for Climate sustainable Cities (ICSC) and Rice Watch.
Local Government Units	Calamba Local Government Unit.
Research and academia	The Oscar M. Lopez Center for Climate Change Adaptation and Disaster Risk Management Foundation, Inc.; the Environmental Science for Social Change Institute; The Manila Observatory.

8.2.3 Information dissemination in PAGASA's fora

The consultant also took the opportunity to attend meetings and talk briefly about the project and invite participants to complete the online survey. She participated in PAGASA's 72nd Climate Outlook Forum, a meeting of the Philippines Climate Change Adaptation Programme and a regional meeting organised by United Nations Development Programme (UNDP) and DFAT.

8.2.4 Preparation of questionnaires for the online survey

The Met Office, DFID and PAGASA were interested in acquiring different types of information through the survey. The Met Office was more interested in identifying which type of information was useful for different users (in order to design the project information products), DFID was more concerned with the process through which information was used and PAGASA were keen to know if the information that they produce currently was relevant and understandable, and how they could improve. They were also interested in how such information was used.

The project team had originally agreed to prepare two types of questionnaire for the online survey: one for users and one for producers of climate hazard/risk information. When starting the preparation of questionnaires the project team recognised that the main difference was not between users and producers of information, but between categories of stakeholders, given that

different categories have traditionally different access to information. In general, the Government category at national level has more access to information than Local Government Units and the Research and Academia group produce information but do not necessarily disseminate it outside peer reviewed journals or educational institutions. In addition, different economic sectors use different levels of information complexity. For example, agencies responsible for the production of technical information use a much more complex language than that of institutions disseminating information to different audiences, but the latter may consider themselves as producers of information, even if they are only translating it from highly technical language to something more accessible to the general public.

To fulfil the requirements of the project team in the Met Office, DFID and PAGASA, and to account for the difference between stakeholder categories, the project team designed six questionnaires for different groups of stakeholders, including National Government, Local Government Units, Academia and Research, Private Sector, Civil Society groups and International/cooperation agencies. The questionnaires are included in Annex V.

The questions were similar in some cases but were phrased in a way that was relevant to the different groups. The questionnaires also contained a few questions relevant for specific groups. They consisted of three parts:

- Part I, Personal and Institutional Data: To acquire information on respondents, including personal data, their work affiliation, sector, activities of their employers and their type of work.

- Part II, Current Climate Hazard and Risk Information Usage: This section aimed to identify the level of knowledge of respondents regarding climate hazards, vulnerability and risks. It was also meant to identify which information was available, how it was being used and if respondents were involved with disaster risk reduction, adaptation to climate change or information dissemination. These questions were slightly different for each group of stakeholders.

- Part III, Information Needs: This section was designed to find out what type of information different groups and sectors required and to analyse what type of information users needed for their work. The questionnaires asked participants to locate four information tools (three national ones and one foreign one) and comment on what they considered useful or needed for their work. The questionnaire also asked them to comment on how these tools could be more useful and what else would they need to carry out their work. This section was common to all stakeholder categories.

The survey questionnaires were prepared in Microsoft Excel, dividing the questions by category of stakeholders. Most of the questions were open-ended to allow participants to provide their comments and opinions. The survey also contained a few multiple-choice questions, matrices and closed-ended questions. Closed-ended questions (which limit the answers of the respondents to response options provided on the questionnaire) were mostly generic questions, e.g. gender, age group.

The Excel file provided information on the purpose and analytical value of each question. The Met Office staff had the opportunity to revise and comment. The project team spent 3 weeks on the questionnaires (2 for preparation and 1 for review).

8.2.5 Uploading questionnaires to an online platform

The project team decided to use an online platform for the survey. This would allow more access to the questionnaires and also more freedom for users. In principle an online survey is more interesting for users, as they have interactive tools that can help them complete the questionnaires. The project team considered a few platforms before subscribing to “Survey Methods” (https://www.surveymethods.com), where the questionnaires were uploaded.

All questions were uploaded in a single survey, instead of opening 6 different surveys, using the “skip logic” function provided by the platform. This function allows for redirecting users to specific questions, so that each group of stakeholder could only read the questions addressed to them.

The survey comprised 145 questions, divided as follows: 19 for National Government Agencies, 16 for Local Government Units, 21 for International/cooperation Agencies, 20 for Academia and Research, 19 for Civil Society Organisations and 21 for the Private Sector. In addition, 18 common questions were included in each questionnaire (personal data and user needs questionnaire).

The platform was set up in such a way that the questionnaire could be completed in stages, given its length.

8.2.6 Opening the survey

Participants were contacted individually to increase the probability of interest in participation. A Microsoft Outlook email address was created to carry out the survey, but it created a further delay, as Outlook allowed only about 40 emails to be sent per day (as a measure against spam). The invitations were released over a week.

A total of 276 individuals were directly invited to participate in the survey. Invitees received an email that introduced them to the project—using the project brief information—and the purpose of the survey. The distribution of invitees is shown in Figure 5. The contact database that was used is available in the online library that accompanies the products of this work package.

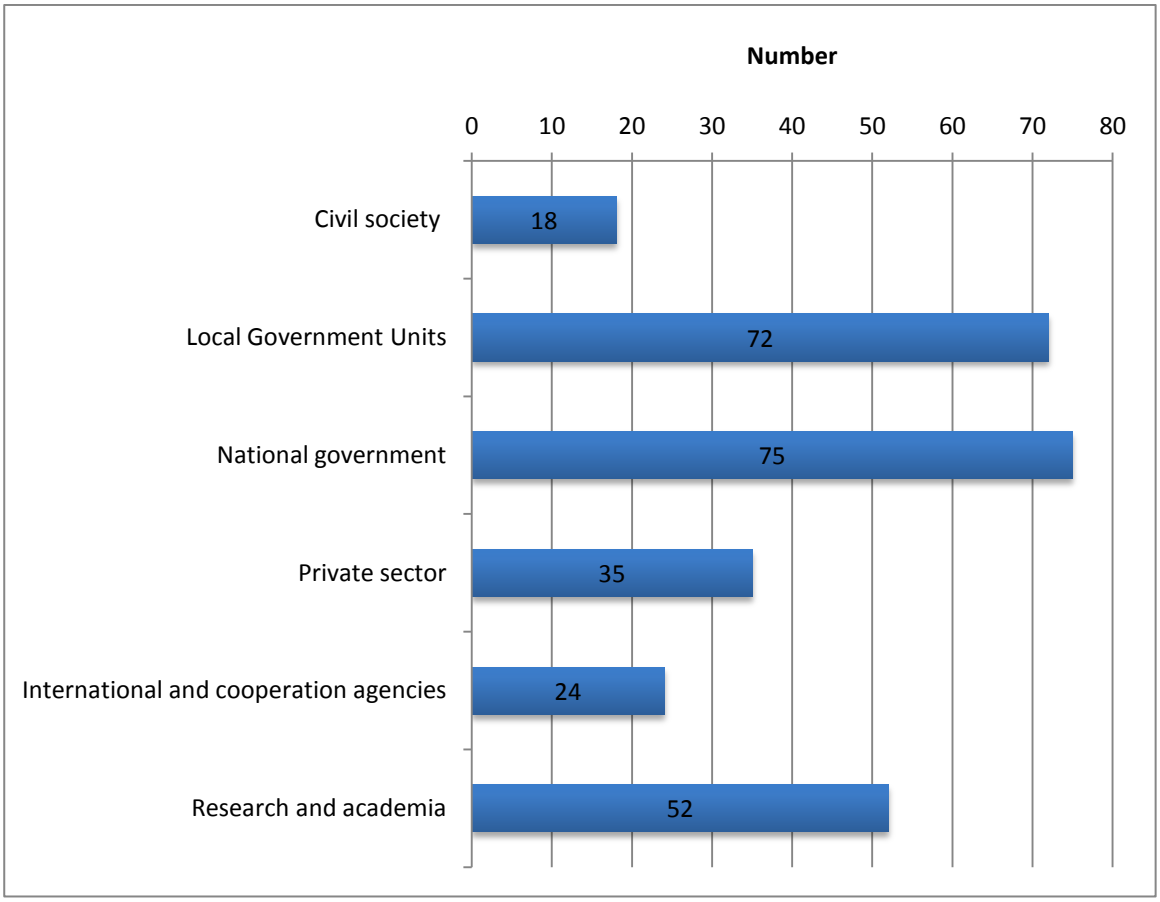

Figure 5. Distribution of invitees according to stakeholder category.

In addition, the Department of the Interior and Local Government, through their CODIX division, released a memorandum to Local Government Units, inviting them to participate in the survey. The Department of Environment and Natural Resources, through the Undersecretary/Chief of Staff also extended an invitation to their attached agencies and bureaux. The Oscar M. Lopez Center offered to advertise the survey on their website and prepared a brief announcement for that purpose.

The project team opened the survey from 19 May to 19 June 2015. The official closure date was 10 June, but the survey was left open for those participants who had started the survey before the closure date but had not completed it. Participants were also given the choice to ask for a Microsoft Word version of the questionnaire, in case they did not have a reliable Internet connection.

8.2.7 Follow up with survey participants

The online platform gave the opportunity for participants to fill the questionnaire throughout the period in which the survey was open, which meant that a participant could start filling a questionnaire and continue with it a few hours or days later, as long as the survey was still active.

The consultant followed up by email with about 100 participants who had partially completed the questionnaire, encouraging them to complete it.

The project team followed up with DILG, providing a couple of updates on response of Local Government Units, and DILG followed up, requesting further participation.

8.3 RESULTS AND RECOMMENDATIONS

8.3.1 Project brief

The project brief was useful to introduce participants to the aims of the project. It was generally welcomed, also by PAGASA, who could use it to inform other initiatives of the activities carried out by the project. The brief was also sent to survey participants to make sure that they could understand the project context and the importance of their participation.

8.3.2 Interviews

In total the project team carried out 32 face-to-face interviews (and maintained contact with 2 stakeholders by email).

The constraint for the number of interviews was the availability of interviewees, the travelling time—Metro Manila is a large metropolis that requires significant commuting time between different neighbourhoods or cities—and the decision to leave some stakeholders until a later stage, where the project products were better delineated.

Phasing the interviews had the purpose to reach high decision making levels once concrete products could be offered. Examples of institutions that were scheduled for a later stage included the Presidential Communication Office and high-ranking officers at the National Economic and Development Authority. Officers at these levels have a busy schedule and need to identify concrete products that can help them in their work.

In general, interviewees welcomed the project and saw the potential to use its potential products. Most of them were particularly interested in learning how climate change could influence the recurrence of hazards and associated risks in the future.

Some stakeholders, such as officers from the Australian Department of Foreign Affairs and Trade (DFAT) and the German Cooperation Agency (Deutsche Gesellschaft für Technische Zusammenarbeit, GIZ), were fundamental in showing the project team the variety of hazard/risk mapping exercises that have been carried in the Philippines since the year 2000. From these interviews it was obvious that both DFAT and GIZ have been pivotal in working with hazard/risk identification. Many initiatives have been funded and coordinated by DFAT.

The different discussions revealed that there are several institutions in the country working with geohazards and that some initiatives have different methods and results in specific areas. The Mines and Geosciences Bureau (attached to the Department of Environment and Natural Resources), PHIVOLCS (attached to the Department of Science and Technology) and PAGASA (attached to the Department of Science and Technology) have been working on hazard information for decades. The Nationwide Operational Assessment of Hazards programme was created in 2013 and the Climate Change Commission has also started producing information with the assistance of some of the universities.

Having so many information providers can create problems, especially if they have different methodologies. While this may be good for scientific purposes (comparison and validation), it creates confusion for end users, who may not be sure what information to use and which method is more reliable.

Several interviewees from different stakeholder categories highlighted that what the country needs more than a new set of maps, is coordinating and extending the work that has already been done over the years. They also identified the need to build capacity for Local Government Units to understand hazard/risk concepts and to be able to produce, update and use hazard/risk information by themselves.

The interviews revealed that the work on hazard/risk is still coordinated and carried out by institutions at national or international level, but that some institutions, especially from the academia and research groups, for example the Environment Science for Social Change Institute, the Oscar M. Lopez Center and the Manila Observatory, among others, are contributing to build capacity of Local Government Units so they can produce their own assessments.

The interviews constituted a good bridge to reach authorities at national level that could use and disseminate the information produced by the project, they also provided a good overview of the work carried out in the country that could help identifying opportunities for the project to be more relevant.

The project team should continue reaching out to other stakeholders as well as informing the interviewees of the results of the survey, including making available project products and reports. While this should be done through PAGASA, the Met Office can contribute to facilitate further communication initiatives by preparing short information notes and promoting further interviews during the visits of the Met Office staff to the Philippines.

8.3.3 Online survey

The process of acquiring the subscription of the platform took longer than expected. The platform proved to be slow in the Philippines, resulting in a very slow uploading of questions, even when using private connections (generally considered faster). Altogether, there was a delay of three weeks compared to the dates proposed initially.

The survey recorded 163 responses. An additional participant completed a questionnaire in MS Word format. The participation rate was 54.7% of the initial number of invitees (300); higher than initially expected (about 30%). This was a high response rate, especially considering the

questionnaires were long and that Internet access is not fast or easily available outside the major cities. This might indicate that hazard/risk information is considered important and that people considered it was worth making an effort to participate in the survey.

The project team reviewed questionnaires and deleted those which were empty, duplicated or that only had data in Part I (personal data). The majority of the deleted questionnaires contained contact data, which the project team kept in a separate file to increase the contact database.

The online platform considered that a questionnaire was complete when a participant submitted it through a “submit button”, but this did not mean the participant had answered all the questions. Given that some participants completed questionnaires but did not submit them through the “submit button” and that some submitted questionnaires but did not provide replies for all questions, the project team included in the analysis the 108 responses remaining after cleaning data (55 complete and 53 partial).

To cope with different types of data that PAGASA, Met Office and DFID required, the questionnaires ended up being long, which probably contributed to the high rate of partial responses. A summary of the results of the survey follows, below:

Size and composition of samples

The distribution of respondents among stakeholder categories (Figure 6) was: National Government (60), Local Government Units (27), civil society (5), research and academia (4), private sector (7) and international organisations (5). Some respondents from local government units, in particular from provincial and regional offices, replied on the national government questionnaire, but since the questions were different, the replies could not be considered as part of Local Government Units survey.

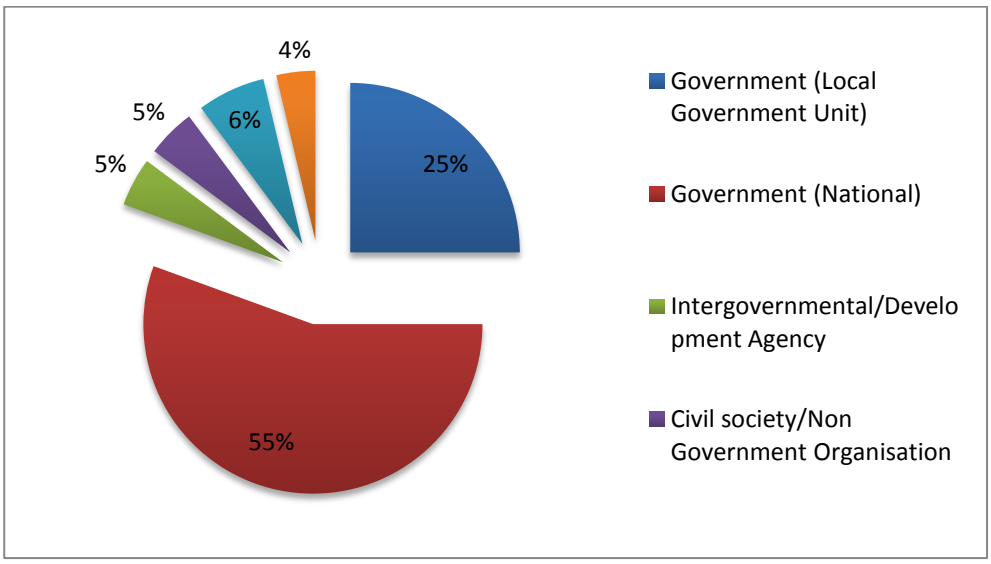

Figure 6. Distribution of survey respondents.

Government levels represented in the survey included national, regional, provincial, cities and municipalities. There were no completed replies from Barangays. Barangays are normally the offices with least capacity and perhaps with no easy access to computers or the Internet, but they are the ones who are closest to communities.

National government respondents represented various subsectors: civil defence, disaster risk reduction management, infrastructure maintenance (highways and public works), science and technology, peace and order, agriculture, agricultural training and extension, food regulation, natural resources management, governance, administration and legislation.

Representatives from the Civil Society group worked in institutions dealing with climate change, food production, sustainable development, environment and agriculture.

The private sector respondents came from the following subsectors: salt production, electricity generation and information technology.

Respondents in the research and academia category came from a private research centre, a government research institution and a state university.

The respondents from international/cooperation agencies, included GIZ, USAID, the British Foreign and Commonwealth Office and the Alliance for Safe and Sustainable Reconstruction.

The size of the samples for the private sector academia and research, civil society and cooperation agencies groups could not be considered statistically significant, as they were too small. Given the nature of questions (mostly open-ended), the analysis could only be qualitative.

Age of participants:

Age was requested as a means to determine the distribution of potential information users, which could have an impact on preferences of information delivery and style. The segments 20–35, 35–45 and 46–60 were almost equally distributed (about 30% each). There were a few respondents from the 61–75 segment.

Gender

Respondents were 51.4% female and 48.6% male. Gender was requested to try to detect if it had an influence on hazard or risk perception. No significant correlation was found.

Hazard ranking

The questionnaire requested all stakeholders to rank climate hazards according to the importance for their sector, with 1 being the most important (highest impacts) and 14 being the least important

(lowest impact). In this way the lowest scores would show the hazards considered the most important, for example, most participants ranked typhoons within places one and two therefore typhoons recorded the lowest score. This system was used as it was the only one available in the online platform.

Eighty-three participants ranked hazards. The combined responses indicated that they considered typhoons, tropical storms and heavy rainfall the most important hazards, while the least important were sea level rise, tornadoes and hailstorms (Figure 7).

It is interesting to note that even with the geophysical features of the Philippines, for respondents, in general, sea level rise was not considered an important hazard (it is ranked the third least important hazard). This might indicate that the perception of hazard is based on historical events and currently there is no inclination to look at hazards under potential future conditions. This might also be supported by the fact that the questionnaires asked participants the reason why they ranked hazards the way they did and that most replies involved experience and recent events.

The questionnaire also asked participants to identify the impacts of those hazards. The following percentages of respondents provided information: National government (55%), Local Government Units (63%), Civil Society (57%), Private Sector (67%), Research and Academia (50%) and International Organisations (80%). Most of the information provided showed they understood the impacts of different hazards well.

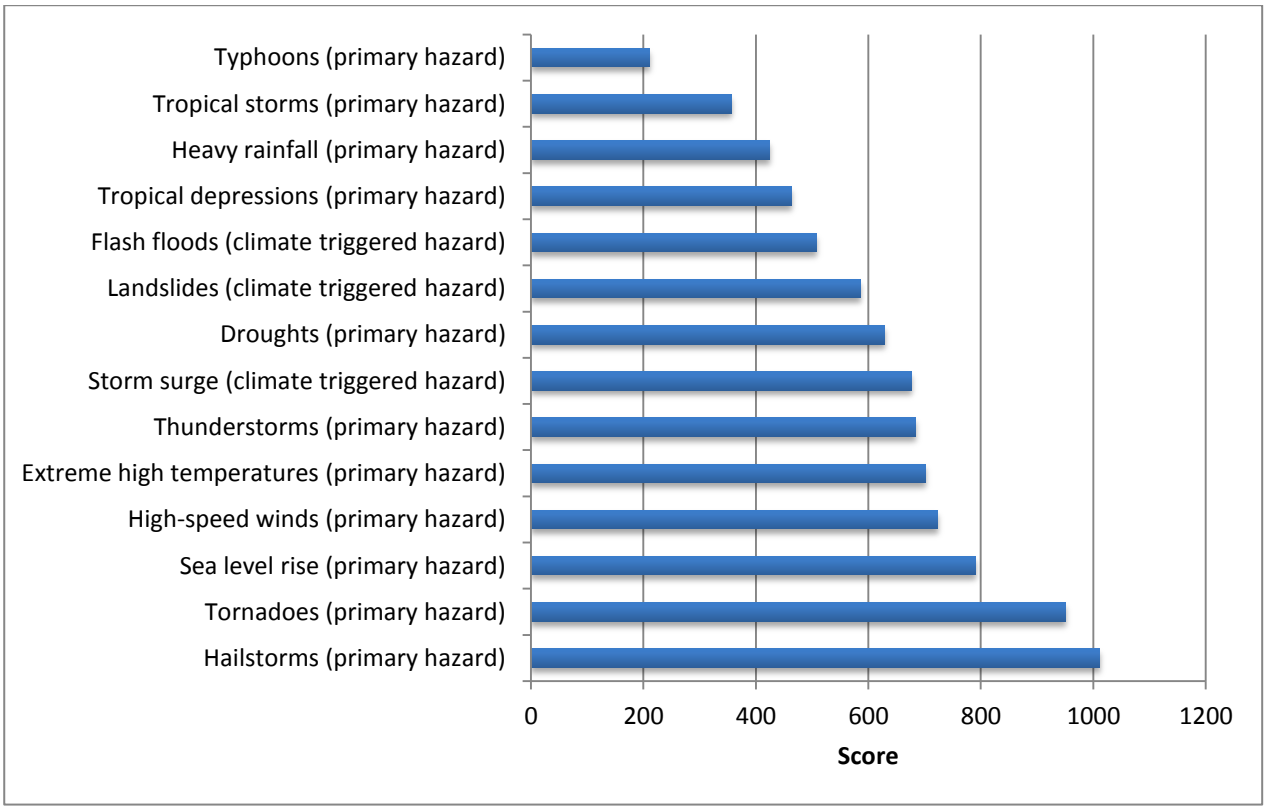

Figure 7. Hazards as ranked by 83 respondents (lowest score represents the most important

hazard).

Hazard/risk information availability, awareness and usage

The next part of the questionnaire tried to give an overview of information availability, usage and to identify who were providers and who were users. Questions also tested the understanding of participants with regard to the difference between hazard and risk, as well as the understanding of hazard/risk based on historical data and hazard/risk based on future climate scenarios. The results for these questions are summarised in Table 4.

Table 4. Summary of the availability, usage and understanding of hazard and risk information for the six categories of stakeholders. The percentage of replies is compared to the total number of respondents for each group sample.

Topic	Government (National) 60 replies	Government (LGU) 27 replies	Civil society groups 5 replies	Private Sector 6 replies	Research and Academia 4 replies	International Cooperation 5 replies
Production of climate hazard/risk information.	50% of this group stated that their institutions produced information.	81% claimed they produced information on climate hazards, vulnerability or risk.	43% replied that they were involved with climate hazard/risk information production, mostly in the form of community based vulnerability assessments.	33% replied that their companies did produce information, but none of them provided references or examples.	50% replied they produced information and 25% provided references.	80% stated they produced hazard/risk information. All respondents provided relevant examples.
Awareness of hazard information (historical data).	50% stated they knew of available information.	Respondents identified most vulnerable sectors based on historical data: Agriculture, environment and water resources.	20% mentioned they were aware of studies specific to their sector (agriculture) but their references pointed out to good practices, rather than hazard information.	33% were aware of hazard information specific to their sector, but they did not provide references.	50% were aware of hazard studies specific to different sectors, but only 25% provided examples.	80% mentioned they were aware of studies and their institutions carried out some of them.
Awareness of risk information (based on projections).	45% mentioned they were aware or risk information, but they provided examples of initiatives that did not deal with risk (e.g. only climate change projections) or that did not work with projections.	25% were aware of studies related to future climate risks to their LGUs. Replies did not provide evidence of specific studies.	75% mentioned that if available they could use it for advocacy, planning and information dissemination.	33% mentioned they were aware of risk information specific to their sector, but they did not provide references.	75% were aware, but the respondent who provided further information quoted product NOAH, which according to available information, do not link risks to projections.	80% replied they were aware of risk studies using projections, but they quoted projections, as opposed to assessment of risks under projected climate trends.

Effects of extreme events.	48% cited effects and provided relevant examples.	63% identified impacts from different hazards.	57% provided examples; they focused more on the effect on communities, rather than on physical assets.	50% mentioned they knew the effects and gave examples of specific impacts to their sectors and their company assets.	25% mentioned they knew where to find information on extreme weather events but mentioned climate scenarios/projections as references.	60% reported they knew where to find information on extreme events, pointing out to the Office of Civil Defense and PAGASA.
Operation in vulnerable areas to climate hazards.	42% indicated they worked in areas that were considered vulnerable.	63% replied they had identified vulnerable areas.	57% answered they did operate in vulnerable areas.	17% provided a reply, mentioning the vulnerable areas where their companies had operations.	None of the respondents recognised having operations in particularly vulnerable areas	60% reported operating in vulnerable areas, including Leyte, Region 8, also Albay, Sorsogon, Isabella, Caraga, Mindoro, Negros and Samar.
Current usage of hazard mapping.	48% used them. Examples of uses: zoning; highlighting high risk areas and vulnerable sectors; formulating disaster risk reduction plans; supporting land use planning; as a basis to formulate or pass legislation.	48% said they did use them, mainly for land use planning and identifying areas at risk.	28% of respondents replied they used them (planning).	17% replied they used hazard mapping in their work (for typhoon tracking).	25% mentioned they used hazard mapping for strategic planning for capacity building. Also for research on climate change awareness.	60% reported using hazard maps to support local governments with land-use planning. One respondent mentioned that they produced them.

Potential usage of information on future typhoon risks (under climate change).	53% replied. Responses varied, in some cases going beyond disaster risk management, e.g. adaptation, education, capacity building. Expectations of how to use it ranged from early warning systems to long term planning, better delineation of critical areas and the possibility of helping people to understand, prepare for and reduce risks.	41% provided answers on how would they use the information, most of them for land use planning, DRM and information dissemination.	57% said they would use it. Examples of use included, research and analysis, for campaigning and for strategy development.	33% replied to this question and provided ideas of how to use it. Mainly forecasting and locating operations.	66% replied they seldom had access to information on typhoon risks but if they would use it for future research and teaching. If at high resolution, they could use it in agriculture planning and to support government work.	80% provided ideas of how they could use it, including combining with other studies, comparing simulations and using them for early warning systems planning.
Relation to Early Warning Systems (EWS).	61% replied their institutions were involved in EWS, either as those generating information (providing data from weather stations), or being recipients of EWS information. Still the line between EWS and wider disaster risk management programmes was blurred.	59% indicated they had access to early warning systems, although some were not yet operational.	29% indicated they were related to EWS. Most in connection to agricultural practices.	50% recognised they were linked to EWS. Examples: country systems and their own Business Continuity Management Systems (BCMS).	25% replied they were involved but did not provide details.	60% replied that they supported the government in setting up EWS.
Engaging local communities to address climate risks.	Not asked, as institutions dealt with national policies.	55% indicated they worked with communities and provided examples of initiatives.	57% mentioned they assisted communities to understand and cope with risk as well as to adapt to climate change.	They were asked if their risk management strategies considered communities. Twenty percent answered positively.	They were asked to provide examples of projects. Seventy five percent provided answers.	80% of the institutions supported activities that help communities to address climate risks.

Involvement with Disaster Risk Management (DRM)	47% reported to be involved. Several came from DILG, they identified DILG as being the vice chair of the National Disaster Risk Reduction & Management Council (NDRRMC) while other mentioned DRRM in the context of local government units.	48% indicated that they had a person or section dedicated to DRM. Some indicated their DRM offices were not active.	43% mentioned their institution was involved with DRM and 28% that their position was involved with DRM.	17% mentioned they were involved with DRM through their Business Continuity Management Systems.	25% replied their institutions were involved with DRM, but none that their position involved DRM. Still, 50% replied that their institutions were developing DRM plans.	80% of respondents mentioned their institutions had been supporting the Philippines Government to build DRM since the 2000s.
Involvement with climate change adaptation	57% responded they were involved but they did not provide many examples.	56% reported supporting communities to address climate risks.	57% mentioned they assisted communities and local government units to adapt to climate change.	33% replied their companies were taking steps towards climate change adaptation, but their responses reflected that they were not clear what it was.	They were asked to provide examples of projects, 75% provided answers.	80% provided examples of projects through which their institutions have assisted the Philippines government to adapt to climate change.

The information producers were located within the government samples and the international cooperation agencies. In fact, all respondents within the latter group had been involved in assisting the government to produce information.

The awareness of hazard and risk information and the understanding of hazard and risk terms vary between groups, with the international cooperation group being the one with the largest percentage of respondents who were aware of available information and understood terminology, as shown by their replies to different questions.

From the general sample, fewer than 50% of the respondents reported to be aware of the availability of hazard or risk information. Answers provided by respondents showed that even if they knew of the existence of information, it did not mean that they understood it. They often confused hazard with risk and did not distinguish between hazard/risk based on historical data and hazard/risk under potential climate change scenarios. The terms "early warning system[d]" and "disaster risk management[e]" were used interchangeably in many cases.

Even within the national government sample, which traditionally tends to have more access to information, terms were often confused. For example, some respondents confused weather or climate information with hazard or risk information. For the question "Does your institution produce hazard/risk information? And if so, please provide examples", some respondents replied that they had information from their local weather stations (e.g. temperature and precipitation). Weather parameters are not hazards per se. Some others mixed vulnerability of ecosystem components or air quality with climate risks.

Between 45% and 63% of the participants could identify the effects of climate extremes on different sectors or in their locations. In general, the replies indicated that they understood the impacts. Examples of impacts included damage to infrastructure, damage to agricultural production, disruption of services, reductions of income and damage to property. The groups that

---

[d] Early warning system (EWS): The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities, and organizations threatened by a hazard to prepare to act promptly and appropriately to reduce the possibility of harm or loss. (IPCC, 2014). An EWS is a component of Disaster Risk Management.

[e] Disaster Risk Management (DRM): Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development. (IPCC, 2014)

provided the largest percentage of replies were the International Organisations and the Local Government Units, while Research and Academia recorded the lowest (25%).

In general, all sectors reported having operations in vulnerable areas, apart from the Research and Academia respondents. Some identified those areas that tend to be considered as priority by the government, e.g. Leyte, Isabella, Caraga and Bicol.

There was also a difference in the usage of hazard mapping between groups, with the Private Sector, Research and Academia and Civil Society Groups using them the least (17%, 25% and 28%, respectively). The International Organisations (60%), Local Government (48%) and National Government (48%) groups recorded the highest usage of maps.

All groups recognised they could use the information on future typhoon risks. The International Organisations were again the group that had more concise ideas of how they could use it, followed by Research & Academia and Civil Society. It is interesting to note that fewer respondents from LGUs provided ideas of how they thought they could use this information. Examples of ideas of how they could use the information on future typhoon risks included: identification of high risk areas, comprehensive land use planning and advocacy to make communities aware of possible risks in high risk areas.

At least 50% of the respondents from the National Government, LGUs, Private Sector and International Organisations groups mentioned they were involved with Early Warning Systems, while Research and Academia and Civil Society Groups were least involved. This may be because traditionally these systems are operated by the government—and often supported by private sector or foreign funds. The Civil Society Groups sample was too small to determine whether they are not very active in the Philippines, but in other countries this stakeholder group is fundamental to work directly with communities to set up and run EWS.

Stakeholder groups replied that they worked with or engaged communities to reduce the impact of climate risks. A respondent from the private sector mentioned an interesting example. He reported that their Business Continuity Management System[f] “contemplated interaction with local communities”. This suggests that some private sector companies are already thinking about ways of working with communities. This could be an initiative to replicate. Protecting common assets and the financial support of the private sector may be a good entry point for joint initiatives and an

[f] A framework for identifying an organization's risk of exposure to internal and external threats, including natural disasters.

important contribution to the government efforts for disaster risk management. Often the protection of assets has been the reason why people do not leave areas at risk when alerted of an imminent hazard. Perhaps the experience and support of the private sector could provide more confidence to communities.

Apart from the international organisations group, less than 50% of respondents reported being involved with disaster risk management. It is surprising that the respondents from the LGUs group were not more involved, given that they can coordinate efforts for preparing for and mitigating the impacts of natural disasters. The apparent low involvement of LGUs with disaster risk management may indicate the lack of resources (both in terms of technical capacity and funds). This again points out the need of reaching out more to local government units at municipal level.

Respondents from all groups mentioned that they are carrying out efforts for adapting their sectors or areas of responsibility to climate change. Examples of projects or initiatives included: formulation of policies to support communities, participation in farmer field schools, preparing Local Climate Change Action Plans, conducting training, providing technical assistance, experimenting with planting methods to cope with changes and rehabilitation of local flood early warning systems in selected watersheds in Leyte and Samar Islands, among others.

Identifying climate hazard/risk information user needs:

The last part of the survey dealt with user needs. Participants were asked how easy it was for them to access the Internet, to determine if the Internet is a feasible way of disseminating information. Twenty-six percent stated that they had easy access, 30% stated that they had relatively easy access, 8% said it was difficult for them to access the Internet and 36% did not reply.

If they had no access to the Internet, the materials they considered more useful were printed maps (98.5%), and printed reports (94%), while mobile phone applications (89.5%) and radio communications (82%) were also considered useful, but less so.

User needs

The last part of the survey asked participants to rate four websites containing climate and climate hazard or risk information. This had the purpose of identifying features that different types of users would find more or less useful. The comments included were mentioned at least once and in some cases they have been paraphrased to make them more understandable.

The websites to be rated were:

- PAGASA website (as of May 2015). The general website was provided in order to test if participants were able to locate hazard/risk information.
- Bangladesh climate risk tool (The Met Office). This is a tool that contains risk information. It

was provided to test if the features contained in this tool could be considered useful.

- The website of the Nationwide Operational Assessment of Hazards (NOAH) (as of May 2015) – The home page was provided in order to test if participants were able to find the information they needed.

- The website of the Geoportal Project from the National Mapping Authority (NAMRIA) (as of May 2015). This website compiles different mapping efforts and has different applications for specific uses. For example, there are applications for tourism, route finding and disaster risk reduction and management (DRRM app). The general website was provided, to test if users could find the DRRM app dedicated to disseminate geohazards maps.

Views on the functionality and usefulness of each tool varied widely. Some participants considered them very useful, while others thought they were not very useful because they were too technical. In particular, for the representatives of LGUs and farmers groups, this information seemed to be too complex and difficult to transfer to farmers or communities. Some respondents reported that the websites were slow or difficult to open and that they could not understand how information was generated. Some LGUs mentioned that they had their own maps and therefore they did not need to consult the national level tools.

At the same time, some respondents highlighted that these tools did not contain information relevant to their locality. They also stressed that such information was often difficult to get. A summary of features (useful and less useful), comments (positive and less positive), information to improve those websites and how respondents believe they can use the information currently contained in those websites is included in Table 5.

Table 5. Summary of comments on the target websites.

Tool	Useful features	Least useful features	Positive comments	Less positive comments	Additional information that could be useful	How could information be used
PAGASA Website	Weather updates and forecasts; specific studies; basic information on climate change; areas of coverage; precipitation for Early Warning Systems (EWS); typhoon reports; information dissemination; bulletins and maps; flood warnings; weather outlook; weather bulletin.	None; astronomy; the pdf files.	Very useful; user-friendly; easy to understand; conciseness of information; real time; informative; accurate on time; can send text message and radar.	Server is usually down when typhoons approach; difficult to access when usage volume increases; clarity of language; not interesting; maps cannot be overlaid; highly technical; difficult to translate for farmers; sometimes not available; too long to open the sites.	Hydromet hazards; the specific barangays and municipalities that need to be informed on whether there is a weather disturbance; a link/desk for data submitted by local flood EWS; better safety manual; meta data; hourly forecast (rainfall, temperature, etc); explanation of what technical data means; list of typhoons that entered the Philippines (yearly-historical); access should be provided for LGUs, specially for LGUs with no capacity to handle Geographic Information Systems (GIS); number of population affected in the area.	Projections can provide an overview of future climate scenarios; preparedness; a general pattern of weather in a certain province or region; possible strategies and approaches during a typhoon and other disasters; risk assessment, warnings; GIS downloadable; regular update for travel advisory; disseminating to all concerned local government sectors; input to planning and management; EWS; research and instruction purposes; can send information and advisory through text; DRRM plans, contingency plans; Information and Education campaigns and advocacy.
Bangladesh Climate Risk Mapping Tool, Met Office	Interactive maps; tools; areas of coverage; format for possible replication; all; maps; current risk; climate conditions; climate mapping tools; useful.	None; socio economics.	Visual information; all; if a similar web based tool would be developed for the Philippines, then it would be useful; partially because the mapping would help if it was in our locality; the design could be adapted to the Philippine settings.	Foreign information; not familiar; none; web interface design; common data; information provided is specific to Bangladesh; highly technical; I don't understand; difficult to translate to farmers; I did not see documentation how data were generated; it looked like high winds and storm surge were in one category; it took longer to load the page; it would appear that it is hard to interpret the map due to lack of technical knowledge; I don't have the technical capability to understand fully the concept.	How the information was generated; input to planning and management; hazard mapping; material for instruction purposes; visual information on climate risks; climate projections; References; information to be distributed through campaigns; risk analysis.	The design can be adapted in the Philippine settings; the socio-economic profile will be very useful in plotting demographics in the Philippines; risk analysis; input to planning and management; hazard mapping; instruction purposes; visual information on climate risks; climate projections; reference; in information and education campaigns and advocacy.

Tool	Useful features	Least useful features	Positive comments	Less positive comments	Additional information that could be useful	How could information be used
NOAH Website (Beta), DOST	Interactive maps; applications and information; government initiatives for climate; areas of coverage; real-time information on rain events in the country; storm surge forecast; precipitation data; GIS data; weather map; satellite image of typhoon; typhoon report; data update; all; flood information; maps; weather updates; strength of typhoons; Doppler; all; hazard map; the amount of rainfall; hybrid maps; weather condition per area; The usefulness of this web is to distinguish the portion of affected area.	None; the pdf files; website not available.	User-friendly; easy to use for our maps; easy to understand; up-to-date information; informative; all; accuracy; information of risk area; projection; we refer to this sometimes; for checking of recent weather report; very useful.	No localized maps; sensor site discrepancies; serious quality concerns; difficulties accessing information; sometimes it requires a password to access the information; some items may not needed; highly technical, difficulty to translate to farmers; this is a bit complicated; no technical knowledge; too long to open and download pdf files; pdf files are hard to use for overlay for LGU planning purposes; localised maps limited; I seldom visit this site; not familiar.	Hydromet hazards; how the information was generated; manual; meta data; more scenarios; improve quality; explanation on what technical data means; access should be provided for LGUs specially for LGUs with no capacity to do GIS; the colour coding of vulnerable areas; easy to access if there is a typhoon.	Flood mapping; risk assessment, warnings; use in multi hazard risk maps; regular update for travel advisory; Input to planning and management; Early Warning System; research and instruction purposes; providing critical information during times of disasters; Doppler location; information dissemination; monitor weather conditions; Flooding Forecast; For DRRM plans, contingency plans; since projection on climate condition is provided, we can use these for planning purposes.
Geoportal, NAMRIA	Various information; all data are available; areas of coverage; collection of maps; additional Information; all; Disaster Risk Reduction application; weather updates; locations and maps.	No transparency button; none; tourism application; information is for sale.	User-friendly; useful; variety of available applications; informative; accuracy; user-friendly.	Information out of date; a bit difficult to navigate; the maps cannot be overlaid; normally our LGU partners have complete maps so there is less need to go to NAMRIA; I seldom visit this site; I haven't heard of it; highly technical, difficulty to translate to farmers; the hazard layers did not display; not available; less information regarding NAMRIA; I have not heard of it; no data on other apps; too long to open the sites; the maps are not for free download if we are to use it for overlay for planning; we always use the NOAH/PAGASA websites; very limited information on climate hazard; we refer to this once in a while because the PAGASA already has information.	How the information was generated; transparency button; meta data, data in GIS format; legend; explanation on what technical data means; access should be provided for LGUs specially for LGUs with no capacity to handle GIS; sea level rise flood maps.	Updating hazards and risk information; plotted socio demographics; risk assessment; less information regarding NAMRIA; input to planning and management; hazard mapping; instruction purposes; GIS or mapping; landslide and erosion; For DRRM plans, contingency plans; IEC and advocacy; for planning.

The questionnaire also asked participants who did not consider any of those tools as useful, what climate parameters, hazards or risk information would be useful, in their view, to support their work. The combined replies from all stakeholder groups included:

- Availability of information: Hazard/risk information by municipality; including information on which municipalities and barangays will be at highest risk; release climate hazard and risk information by watershed; provide local weather stations and corresponding data processing; possibility of having data to process locally for agriculture and livelihoods, given that PAGASA's advisories are general/coarse and do not match the cropping activities in specific areas; comprehensive information on hazard risks that can cover site-specific/localized hazard maps; accurate information pinpointing the specific areas that will be affected by these weather changes so farmers can be guided by science-based evidence; hazard information to be included in the curriculum of elementary and high schools; provide the opportunity to download shape files so LGUs can use them.

- Information tailored to different sectors: Sector-oriented vulnerability assessments (it is unclear if they meant vulnerability or risk assessment) of long term climate change impacts;

- Language for different audiences: Easy to understand language for forecasts, hazard and risk information, particularly at farmer level; simple brochures distributed to farmers, we can explain it to them if it comes in a simpler language; better strategies on information dissemination down to the grass root level;

- Capacity building: Capacity building for understanding hazard information.

- Compatibility of information: many LGUs are unhappy with the borders on official maps and want to use their own borders and determine their own climate change projections; common terminology/standards to be able to compare local with national information and combine with historical event recording by communities;

- Allocation of resources: The Local Government should make the Disaster Department a permanent department and give importance to the work force (improve employment conditions).

It is interesting to note that the requests are not detailed but general. This might indicate that respondents are still not sure what type of information can be used for their specific work. It also supports the fact the information needs to be translated for the different groups using their own language and related to their experiences/sectors.

8.3.4 Summary of information availability and uses

At the moment there are at least five national technical agencies and several departments producing official information on natural hazards. A larger number and a variety of agencies are trying to disseminate this information. However, the results from the survey on this small sample

may indicate that information is not reaching everyone and that there is a large gap in the capacity of LGUs and other groups working with communities to acquire and handle information. In the best cases, and omitting international organisations, about 50% of the respondents provided answers on the more technical questions. This could indicate a lack of understanding of topics or a lack of capacity to reply (or simply a lack of time to reply to a long questionnaire).

It is obvious that work is being carried out, but there seems to be a gap in the distribution of information and the translation for different audiences. It is interesting to note that the barangay level, for example, which has the most immediate contact with communities, was not represented in the sample.

There is also evidence (from results of the survey and interviews) that international organisations have contributed substantially with resources and capacity building efforts, but there is still a need for upscaling the work. That work perhaps needs to be institutionalised or adapted so LGUs can take ownership. There might be a need for a body equivalent to agricultural extension services, that is directly in contact with communities but that is now dedicated to combining natural resources management, development, climate change adaptation and disaster risk management.

Another gap identified through interviews and the online survey is the lack of coherent methodologies and approaches. Each organisation uses its own defined models and standards. These may be good for research purposes, but it creates confusion for end users. Users at the local level, taking decisions and measures to adapt to climate change and reduce impacts of natural disasters, need information that can guide them in their decision-making. If every initiative has a different result, it is impossible for them to understand which course to take.

Another finding from the survey was that information is held by some agencies and often is not available to the public free of charge. Sometimes even agencies that are working towards disaster risk reduction have to pay for information generated by other agencies, unless there are specific agreements to share information. In order to create a better flow of information, channels for distribution should be considered and the budget should consider funds for database maintenance and distribution of information—in a country with so many hazards, this information should be easily available and free for any user who can turn it into information useful for communities. Often there is a problem with accountability, agencies should be accountable for information they post, but they cannot be held responsible for how others use it. Breaking the misconception that only the national institutions are capable of handling data and carrying out data analysis should help to increase information generation at community level.

It is also important that LGUs are encouraged to create and maintain their own information, which would reflect the local situation more accurately. Perhaps it is more important to provide guidelines (and resources) to prepare and maintain local information than to create a one-off set of data that could change if natural hazards modify the conditions in a given location. For example, if a watershed changes physically as a result of a major climatic event (for instance, the course of a river or the terrain are modified), the old hazard maps become obsolete.

In a country that is physically fragmented and with difficulties of communication, decentralisation of information is important. If agencies are not ready to give autonomy to LGUs, then they should at

least consider more funding for establishing or keeping municipal level posts to handle climate risk information.

Even if the last decade has been characterised by the expansion of electronic information, there is still a lot of work to be done. In general, the connections are slow, even in the Metro Manila area. National agencies, in particular, have limited systems, which cannot cope with the demand for information during times of crisis. Other mechanisms need to be used to transfer information.

In addition, there is a need to engage the private sector, academia and civil society groups, government agencies by themselves cannot carry out all this work.

9 LITERATURE COMPILATION

9.1 PURPOSE OF THE ACTIVITY

As part of work package 2 the project team carried out a literature search that would help identify previous studies on hazard and risk, as well as the information producers. The literature collected was stored in an electronic library and catalogued in a database that aims to help PAGASA keep relevant hazard and risk documents together.

9.2 METHODOLOGY

When starting the project the team thought that there would not be much information available, but as the work package progressed it was obvious that there has already been a number of initiatives producing and analysing hazard, and in some cases, risk information. The information was obtained through web searches, ScienceDirect, from PAGASA and other stakeholders that provided information either through interviews or the online survey.

9.3 FINDINGS AND RECOMMENDATIONS

Most of the literature came from national institutions and international organisations operating in the country, either from their websites, reports or project-related activities, with only a few from peer-reviewed papers in scientific journals.

Projects are often not well documented, in particular the sections regarding methodologies for assessments, and if they are, the reports are not easily available to the general public. The project team found it difficult to locate reports/reviews on projects, as often they are considered as confidential. The Australian DFAT was fundamental in providing access to the different projects and reports, as they had been the funders.

The literature collected was organised in a database that contains 73 documents on hazard, risk or vulnerability, 86 data sets and maps, 32 projects and 17 other documents containing climate change information.

9.4 LITERATURE FINDINGS

The Philippines is considered one of the most natural hazard prone countries in the world, due to:

- being situated in the “Pacific Ring of Fire”, between the Eurasian and Pacific tectonic plates and experiencing an average of 20 earthquakes per day;
- having about 300 volcanoes, with 22 considered as active; and
- being located along the typhoon belt in the Pacific, which makes it vulnerable to extreme weather events.

Between 1942 and 1991 there was an average of 19.8 cyclones per year in the Philippines Area of Responsibility (PAR), of which 3.7 were classified as depressions, 5.3 as storms and 10.8 as typhoons (Benson, 1997). In the 1990s there was a near 100% probability that at least four typhoons would make landfall in any year, whilst an average of eight to nine tropical cyclones actually reached land and a further two offshore typhoons also resulted in damage every year (Brown *et al.*, 1991). However, data on maximum wind speeds over the period 1951–1990 suggested that the intensity of cyclones was gradually increasing (Jose, 1993). In 1993, there were 32 typhoons in the Philippines, the highest level since records began.

More recent statistics by the Met Office (Daron & Amato, 2015) suggested that about 17 tropical cyclones (12 typhoons) enter the Philippine Area of Responsibility (PAR) every year.

According to the Germanwatch Global Climate Risk 2015 Index, the Philippines is ranked as the 5th country most affected by extreme weather events between 1994 and 2013 (Kreft *et al.*, 2015) (Figure 8).

Figure 8. World Map of the Global Climate Risk Index 1994–2013.

The east of the country, particularly the north east, is most vulnerable to typhoons. This reflects the fact that 95% of tropical cyclones entering the PAR originate in the Pacific Ocean. The east coast is highly exposed to typhoons with wind speeds greater than 150 km/h.

The occurrence of typhoons is highly seasonal. They are concentrated between June and December, with the highest frequency in July, August and September (Brown *et al.*, 1991).

Typhoons are associated with strong winds, heavy rains and storm surges, which damage buildings, roads, irrigation and other infrastructure. The excessive rainfall seems typically more destructive than the strong winds, particularly in the case of slow-moving or quasi-stationary typhoons (Philippine NLUC, 1992), triggering flooding, landslides and erosion. The scale of damage depends not only on the intensity of the winds but also on levels of precipitation. Even typhoons that do not reach land can generate heavier rains and gusty winds, in turn resulting in damage. Typhoons, as well as other hazards, can also generate storm surges to which the Philippines, with its extensive coastline, is especially vulnerable (Brown *et al.*, 1991).

Severe flooding is normally associated with the heavy rains accompanying typhoons. Mean annual rainfall varies from 965 mm to 4,064 mm. The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) has estimated that approximately 47% of average annual rainfall is due to typhoons, 14% to monsoons and 39% to other weather systems. Eastern Mindanao, Northern Samar, Central Luzon and the Bicol regions are particularly prone to severe flooding.

Severe floods occurred in 1972, 1974, 1978, 1981, 1986 and 1993 (Brown *et al.*, 1991; Pineda, 1993). The 1972 floods were particularly catastrophic, affecting the main rice-producing area of Central Luzon and disrupting commerce and transportation to such an extent that rationing of certain commodities was necessary.

Flooding causes direct damage to agriculture and fisheries, as well as to infrastructure and other assets. Heavy rainfall and flooding also increase rates of soil erosion, creating sedimentation problems for water reservoirs, dams, hydro-electric power stations and other water infrastructure. It also reduces the depth of waterways, lakes and reservoirs.

In addition, the Philippines experiences intermittent droughts occurring at least once every five years and normally affecting the whole country. They are typically associated with El Niño events (Jose, 1993). As well as generating various problems relating to water shortages, droughts can bring increased sea-water intrusion as a consequence of declines in ground water levels, in turn causing additional economic losses over several years.

The number of affected persons and costs of disasters due to tropical cyclones are high. A recent calculation by Yonson (2015) showed that in the period 1980–2013 the average cost per destructive tropical cyclone was USD41 million (Table 6). The data also show that from 2011 to 2013 the cost of damage recorded increased compared with previous decades. This might be a result of population movement to urban areas and an increase in population density.

Table 6. Tropical cyclones and associated socio-economic impacts.

Year	Number of tropical cyclones that passed the Philippines	Number of destructive tropical cyclones	Number of fatalities	Number of affected persons	Total cost of damages (in million USD)
1980	23	6	143	1,666,498	196
1981	23	7	696	1,750,142	161
1982	21	8	389	2,149,167	193
1983	23	4	126	747,155	49
1984	20	4	2,108	4,105,133	362
1985	17	4	211	1,643,142	136
1986	21	6	171	1,524,301	92
1987	16	6	1,020	3,691,555	199
1988	20	5	429	6,081,572	412
1989	19	7	382	2,582,822	207
1990	20	10	706	6,092,959	524
1991	19	6	5,414	1,815,989	292
1992	16	7	118	1,755,811	199
1993	32	14	827	7,363,591	739
1994	25	12	242	3,054,232	121
1995	16	11	1356	7,683,526	590
1996	17	10	124	1,255,289	106
1997	14	6	95	2,399,435	35
1998	11	4	490	7,322,133	563
1999	16	9	103	1,793,742	66
2000	18	9	345	7,284,946	169
2001	17	10	440	3,769,262	135
2002	13	5	169	3,546,469	16
2003	25	10	139	3,362,991	77
2004	25	10	1,232	6,966,136	237
2005	17	5	54	1,019,646	46
2006	20	10	1,165	11,253,211	394
2007	13	8	124	2,998,885	60
2008	21	9	673	7,009,725	452
2009	22	16	1,140	12,250,050	923
2010	11	10	136	2,596,587	275
2011	19	19	1,557	9,884,577	628
2012	17	16	1,386	8,006,126	1,064
2013	25	11	6,389	21,381,374	2,354
Total	652	294	30,099	167,808,179	12,072
Average	19	Share to annual average: 47%	885	4,935,535	355
Average per destructive TC			102	570,776	41

Source: (Yonson, 2015). 1) Number of Tropical Cyclones that Passed the Philippines - Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). 2, 3, 4) Number of Destructive Tropical cyclones, Impacts of Tropical cyclones - National Disaster Risk Reduction and Management Council (NDRRMCC). 5) Annual average exchange rates used to convert cost in PhP to USD taken from Bangko Sentral ng Pilipinas (Central Bank of the Philippines) website (BSP, 2014). Disaster impacts include those resulting from tropical cyclone-induced flooding, landslide and storm surge.

While the loss of life may not be as high as expected from the intensity and frequency of tropical

cyclones that hit the Philippines, the cost of reconstruction is high. The government alone cannot cope with it, the cycle of poverty gets deeper and the proliferation of informal settlements increases, creating more areas at higher risk.

According to the Philippines Climate Change Commission (CCA, 2010), climate change has triggered a rise in temperature and increased variability in patterns of rainfall and super typhoon events. Climate change and variability combined with weather modifying impacts from the El Niño Southern Oscillation (ENSO) have resulted in more complex and unpredictable changes in patterns and intensity of temperatures and extreme rainfall events.

The country has long been exposed to typhoons and droughts even before the on-set of climate change. But the country needs further guidance to be able to identify priorities for adapting the different sectors.

According to Brecht *et al.* (2012), by 2100, 16 million people will be exposed to storm surge risk in the Philippines, a 14% increase compared to those at risk in 2000. In addition, destructive winds and heavy rainfall pose an increased risk of crop failure and low crop production, which could lead to food insecurity (Lansigana *et al.*, 2000).

Sea level rise is expected to increase the risk of flooding and storm damage. Projected impacts of one-metre sea level rise in many areas of the country show vast portions being inundated, affecting coastal settlements and livelihoods. According to estimates of the National Mapping and Resource Information Authority (NAMRIA), a one-meter sea level rise translates to an estimated land loss of 129,114 ha (CCC, 2012).

Institutions in the Philippines have been carrying out efforts to identify areas at risk of natural hazards since at least the beginning of the 1960s. For example, the Mines and Geosciences Bureau has been conducting geohazard mapping and assessments since the 1960s (RAP, 2014).

The Risk Analysis Project (RAP, 2014) highlighted some of the work on severe wind risk:

- In 1984, Amadore *et al.* proposed the Typhoon Damage Scale II (TDS) Model for the Philippines, which is a crude relationship between the surface wind speed of a typhoon and the corresponding wind damage to structures and vegetation at a certain locality.

- In 1986, Kintanar *et al.* first attempted to synthesize climatological information on wind data into a form that would be useful to engineers and designers of building and/or low cost housing in the Philippines. The return periods of maximum wind speed at selected communities were calculated using the standard extreme value analysis.

- Amadore (2011) developed an Idealized Typhoon Damaged Model (ITDM) to simulate the location, maximum winds, direction/speed of movement, radius and size/shape of a tropical cyclone and came up with a typhoon wind profile which became the basis for the degree of hazard. A vulnerability map was generated showing areas at the municipal level with the most number of nipa huts (stilt houses). The typhoon risk-mapping model was limited to wind damage risk, areas on flat/ocean surface and residential structures only.

The oldest reference found of disaster risk management dates to the 1980s—The Philippines Disaster Management System. Another study that summarised the status of disaster risk management in 1997 was “Economic Impact of Natural Disasters in The Philippines” (Benson, 1997) [See Box 1].

***Box 1. Excerpts from “Economic Impact of Natural Disasters in the Philippines” (*Benson, 1997).**

Risk mapping and land use planning.

…Both the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and the Philippine Institute of Volcanology and Seismology (PHIVOLCS) are keenly aware of the importance of disseminating hazard risk information for utilisation in, for example, land-use planning and development, agriculture, building designs and risk management more generally (Jose, 1993). These efforts have been endorsed by the National Physical Framework Plan (NPFP), 1993–2022, which makes the consideration of hazard risks a central factor in determining land use, aiming in part to reduce hazard vulnerability and to maintain environmental stability and integrity by guiding the location of assets and housing and influencing land use. In terms of achieving more equitable spatial development, the NPFP also notes that particular attention needs to be paid to areas which are most vulnerable to natural disasters, including typhoons, earthquakes and volcanic eruptions (Philippine NLUC, 1992)…

…PAGASA has undertaken broad risk mapping of typhoons. Flood-prone areas have also been broadly identified based on topography and historical rain patterns, but no systematic flood-risk mapping has been completed. PHIVOLCS has produced earthquake ground acceleration maps at the national level as well as maps for liquefaction and landslides. It has also produced three types of volcanic hazard maps for the country's six most active volcanoes (see Chapter 2), covering lahars, pyroclastic flows and ash falls…

…These maps have been complemented by laws and regulations aimed at reducing the hazard vulnerability of both people and economic assets…

…However, in practice these various laws are often poorly enforced, whilst public hazard awareness is limited and hazard maps are typically not consulted. Moreover, more extensive and systematic hazard mapping is required, with most existing maps based on historical evidence and often in insufficient detail." Public knowledge about the risks of geological hazards typically appears to be particularly low, despite efforts to reduce this problem…"

…Meanwhile, both lack of awareness and poverty have resulted in the construction of permanent structures and squatter housing on buffer strips and easements, with buildings actually overhanging the rivers in more densely populated areas…

…Involvement in efforts to ensure greater uptake of disaster mitigation and preparedness measures also appear to have played some role in increasing private sector awareness of the risks posed by natural hazards. For example, corporate members of the CNDR would like the organisation to undertake hazard assessments of its members' plans. However, such assessments had not begun as of late 1995 and, anyway, might not always prove sufficiently detailed because of the constraints posed by the more general dearth of detailed, systematic hazard mapping. More generally, efforts need to be stepped up to ensure that land-use regulations are strictly enforced and that public awareness of hazard risks is improved. However, even this is not straightforward as hazard vulnerability itself is dynamic, reflecting changing environmental and socio-economic factors. For example, there is evidence that deforestation is increasing the

frequency and severity of disasters such as flooding which, combined with rising population mobility, may be reducing the level of accurate local knowledge of hazard risks. This was demonstrated by evidence from a survey following the 1991 Ormoc flood, which indicated that many households were unaware of the risk of flooding on the scale experienced, despite the fact that they had been living in the area for many years, basically because deforestation in the locality had increased the potential scale and speed of flash flooding.
Increasing population pressures are also likely to exacerbate difficulties in implementing laws and regulations on land use in the short- to medium-term by forcing poorer households on to more marginal lands. This makes both the conduct and dissemination of detailed and regularly updated risk mapping as well as the enforcement of land-use regulations even more critical. Indeed, the NPFP has called for the immediate adoption of proper infrastructure and settlement planning in areas prone to flood and storm surge and the strict implementation of legislation prohibiting the construction of permanent structures along easements and buffer strips (Philippine NLUC, 1992). As of late 1995, the National Land Use Committee was also proposing legislation to create a more powerful Land Use Commission with much more power to monitor land use at the national level.

Finally, there may be some scope for the introduction of financial incentives to encourage households and the private sector to consider hazard risks when deciding on the location and design of their properties…

9.5 MAJOR HAZARD/RISK PROJECTS

Almost 50 years after the first attempts to map natural hazards, several institutions continue generating hazard and, in some cases, risk data. In general government agencies are the ones generating maps and distributing them, although there are also few initiatives carried out by researchers, international organisations and non-government organisations. Below is a summary of the major efforts found by the project team that had been carried out from 2000 (other smaller projects or local initiatives may also be available).

9.5.1 MAPPING PHILIPPINE VULNERABILITY TO ENVIRONMENTAL DISASTERS

Leading institution: This project was carried out by the Manila Observatory and the Department of Environment and Natural Resources.

Description: It may have been the first comprehensive assessment of climate and geophysical hazards and risks and was completed in 2005. The climate hazards considered were typhoons, temperature increase and change in precipitation. The exposure component was population density (year 2000, 5x5 km grid) and the vulnerability component was the Human Development Index (2000).

A typhoon risk map derived using historical typhoon incidence data from 1945 to 2003 identified the 20 top provinces at risk. The study concluded that Northern Luzon, South-eastern Luzon and Eastern Visayas were the areas at highest risk (Figure 9).

Figure 9. Typhoon risk map derived using historical typhoon incidence data from 1945 to 2003.

The change in annual temperature conditions during the years 2066–2095 compared with the baseline period (1961–1990) was used in the hazard assessment. The resulting risk map also identified the 20 top provinces at risk to temperature increase during the projected 2080 climate, with most of them being in Mindanao and Central Visayas (Figure 10).

Figure 10. Map of risk to projected temperature increase.

Projections of changes in rainfall conditions during the dry season (December to February) and the

rainy season (June to August) for the 21st century (2066–2096) were compared with the baseline data (1961–1990). The resulting map of risk to projected rainfall change incorporated both rainfall decrease during the dry season and rainfall increase during the wet season. The areas most at risk to projected rainfall changes were Central, South and Southeast Luzon and Eastern Visayas (Figure 11).

Figure 11. Map of risk to projected rainfall change.

The scale of the maps produced was 1:5,500,000 (1 cm on the map represents 55 km in the terrain), with not enough resolution to discern information at municipality or barangay level. The assessment did not seem to be taken up or used by other institutions. In fact, few of the people interviewed by the project team knew anything about this assessment. It was not mentioned in the survey either.

9.5.2 HAZARDS MAPPING AND ASSESSMENT FOR EFFECTIVE COMMUNITY BASED DISASTER RISK MANAGEMENT READY PROJECT

Leading institution: This project was a collaboration among the CSCAND Agencies and was carried out with funding from AusAid (now DFAT).

Description: The READY project mapped multiple hazards in 28 provinces that are considered priority for risk management. The maps were handed to the Local Government Units in early 2015 and are displayed in NAMRIA's Geoportal (see below) and the Agos project (http://www.rappler.com/move-ph/issues/disasters/hazard-maps).

The hazards covered were earthquakes, floods, ground rupture, ground shaking, liquefaction, rain-

induced hazard, storm surge, tsunami and volcanic hazards. The mid-term report identified the constraints that the project faced, especially the lack of work force to dedicate time to mapping (four maps were being produced per year). The project team failed to locate the final project report or the methodology used for mapping. Even so, most people interviewed and some survey respondents made reference to READY maps as those used in the country.

Results: The scales of the maps prepared were 1:50,000 and 1:10,000, with a high enough resolution to give more information at the local levels. The storm surge map for Bohol is shown in Figure 12.

Figure 12. Storm surge hazard map for Bohol province.

9.5.3 NATIONWIDE OPERATIONAL ASSESSMENT OF HAZARDS PROGRAMME

Leading agency: The Department of Science and Technology (DOST) launched the Nationwide Operational Assessment of Hazards (NOAH) Programme, in response to the instructions of President Aquino to establish a responsive program for disaster prevention and mitigation.

Description: In the words of project officers “NOAH’s mission is to undertake disaster science research and development, advance the use of cutting edge technologies and recommend innovative information services in government’s disaster prevention and mitigation efforts” (NOAH, 2015).

There are 9 component projects under the NOAH program, namely:

- Hydromet Sensors Development

- DREAM-LIDAR 3D Mapping
- Flood NET – Flood Information Network
- Strategic Communication
- Disaster Management using WebGIS
- Enhancing Geohazard Mapping through LIDAR and High-resolution Imagery
- Doppler System Development
- Landslide Sensors Development
- Storm Surge Inundation Mapping
- Weather Information Integration for System Enhancement (WISE)

On paper the NOAH Programme is a multi-agency initiative, but in practice it seems to be producing its own data. It is unclear what the methodology for, for example, storm surge and flooding is and how these complement (or not) the efforts of other agencies. The programme NOAH is gaining recognition but apparently for many information users is confusing who is in charge of producing climate hazard information and what should be considered the official source.

Results: The NOAH programme has produced two versions of a web platform (http://noah.dost.gov.ph/ and http://beta.noah.dost.gov.ph/#/) (Figure 13).

Figure 13. NOAH Programme platform.

9.5.4 Enhancing Risk Analysis Capacities for Flood, Tropical Cyclone Severe Wind and Earthquake for Greater Metro Manila Area, RAP

PROJECT

Leading agency: This was a multiagency project (CSCAND Agencies) coordinated through the Office of Civil Defense and the National Council for Disaster Risk Management. It was carried out with funds from the Australian Government.

Description: The primary objective of the Greater Metro Manila Area (GMMA) RAP project was to analyse the risk from flood, severe wind and earthquake in the Greater Metro Manila Area through the development of fundamental datasets and information on hazard, exposure and vulnerability. The project:

- acquired 1,311 km^2 of high resolution digital elevation with LiDAR technology (Light Detection and Ranging);
- developed an exposure database, which describes the 'elements at risk' from natural hazards, including buildings and population; and
- assessed the risk and impacts from flood, severe wind and earthquake in GMMA through undertaking the first multi-hazard risk assessment for a megacity;

Results: Flood modelling scenarios in the Pasig-Marikina River Basin proposed that flooding can have impacts on GMMA beyond what was experienced in recent disasters such as Tropical Storm Ketsana (Ondoy). In a hypothetical 0.5% annual exceedance probability (AEP) scenario (1 in 200), the deepest inundation (3+m) would occur along the Upper Marikina and San Juan Rivers, with almost PHP60 billion (Philippine pesos, USD1.3 billion) in physical damage and over 2 million people with inundated homes.

Tropical cyclone severe wind modelling indicated that GMMA may suffer costly losses due to damaged structures (residential, commercial, industrial facilities, critical facilities and other structures), with total costs in GMMA of approximately PHP77.61 Million/km^2 (USD1.65 million/km^2) for the 0.2% AEP (1 in 500). The City of Mandaluyong would have the highest expected economic loss amounting to PHP163.87 Million/km^2 (USD3.5 million/km^2), as it is densely built-up and has high proportions of vulnerable building types.

The project report is available in the project literature database. It details the project scope and documents the methodologies used to calculate the different risks. A series of maps have also been produced. An example of a map for a 0.2% AEP (500-year return period) damaged floor area equivalent (ha/km^2) in Taguig City is shown in Figure 14.

Figure 14. 0.2% AEP (500-year return period) damaged floor area equivalent (ha/km^2) in Taguig City.

9.5.5 GREATER METRO MANILA HAZARDS MAPPING AND ASSESSMENT FOR EFFECTIVE COMMUNITY-BASED DISASTER RISK MANAGEMENT READY PROJECT

Leading agency: This project was a multiagency partnership that derived from the national READY project. It seems to have been coordinated by the Office of Civil Defense. It was carried out with funding from the Australian Government through UNDP and aimed to conclude in 2014. It has been difficult to locate documentation on this project beyond PowerPoint presentations given by the Office of Civil Defense. This project seemed to be more concerned with institutional strengthening than mapping; it is unclear if it was connected to the RAP project described in 9.5.2.

Description: According to the information provided in the UNDP web page (http://www.ph.undp.org/content/philippines/en/home/operations/projects/environment_and_energy/GMMA-READY.html, the project aimed to decrease the vulnerability of the Greater Metro Manila Area (GMMA) to natural hazards and increase their resilience, by strengthening the institutional capacities of the local government units, concerned national government agencies, academic institutions and civil society organisations to manage disaster and climate change risks. At the

national level, the project aimed to institutionalise and standardise Disaster Risk Management measures and processes, while at the local level, it aimed to empower the most vulnerable cities and municipalities in the Philippines and to enable communities to prepare Disaster Risk Management plans and to integrate them into their respective land use development plans.

The project attempted to achieve this outcome by:

- Assessing the GMMA's vulnerabilities to disaster and climate change risks;
- Developing and implementing priority disaster/climate risk mitigation (CRM) actions for GMMA such as formulation and testing of an integrated contingency plan and establishment of early-warning systems;
- Enhancing the competencies of GMMA LGUs and critical partners to mainstream DRM/CRM into local planning and regulatory processes;
- Demonstrating the mainstreaming of DRM/CRM into local land use/development plan(s) and regulatory processes of Metro Manila and selected GMMA LGUs;
- Establishing a knowledge management system, including a vigorous Community of Practice on Disaster/Climate Risk Management.

9.5.6 PROJECT CLIMATE TWIN PHOENIX AND THE RESILIENCE AND PREPAREDNESS FOR INCLUSIVE DEVELOPMENT (RAPID) PROGRAMME

Leading agency: In April 2012, the Project Climate Twin Phoenix (PCTP) was launched under the Climate Change Commission (CCC), with technical assistance from UNDP and the Australian Government. The Project Climate Twin Phoenix is on-going and implements its activities in the cities of Cagayan De Oro and Iligan and the Provinces of Compostela Valley and Davao Oriental.

Description: The project was designed as an urgent and more focused intervention prioritising climate change adaptation and disaster risk reduction actions and initiatives in some cities and municipalities. It has four main components:

- Climate Change Vulnerability/ Disaster Risk Assessment
- Development of Priority Climate Adaptation and Disaster Risk Mitigation Actions
- Information, Education and Communications (IEC) Campaign and Competency Development
- Socio-economic Resilience Development for the Poor and Most Vulnerable

The CCC partnered with the University of the Philippines Training Center for Applied Geodesy and Photogrammetry (UP-TCGAP) to undertake a river basin and flood modelling study of four river

systems that traverse the cities Cagayan de Oro, Mandulog, Iponan and Iligan. The study covered profile and cross-section surveys, inflow measurements, flood inundation modelling and watershed and climate change impact analyses. It incorporated projected rainfall generated by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA).

Results: The features of the climate-adjusted maps produced so far include:

- Climate change considerations. Climate-adjusted flood hazard maps for 2013, 2020, and 2050 were prepared for Cagayan de Oro City and Iligan City corresponding to rainfall return periods (5-year, 10-year, 25-year, 50-year and 100-year) extracted from the rainfall intensity duration frequency data of PAGASA. The impact of climate change was considered with simulation of rainfall return periods applied on predicted land cover changes to determine the rainfall-runoff from the watershed for years 2013, 2020, and 2050.

- Differentiated flood susceptibility levels. The climate-enhanced flood hazard maps depict differentiation in flood inundation susceptibility levels. The areas inundated by different flood depths vary according to the scenario generated for various rainfall return periods (5-year, 10-year, 25-year, 50-year and 100-year) and 24-hour duration. These were generalized to five level types (less than 0.1m, >0.1 to 0.2m, >0.2 to 0.5m, 0.5m to 1.0m, >1.0 to 2.0, >2.0 to 5.0m and >5.0). This is a departure from the traditional flood hazard maps that only indicate different degrees of susceptibility.

- Probabilistic characterization of flood hazard maps. Probabilities of occurrence can now be inferred based on the rainfall scenarios that were simulated. The generation of probability-based hazard maps is a step towards risk assessment which will be useful in the different facets of flood mitigation ranging from design considerations in structural measures to risk financing.

- Two dimensional flood modelling. Ordinary flood models show the expansion or contraction of river carriage according to discharge from the watershed and not those caused by surface flooding. Because two dimensional models were used in generating the climate-adjusted flood hazard map, it was able to show areas flooded not only due to overflowing rivers, but also from storms assuming an overwhelmed drainage system. Design of new drainage systems will benefit from knowledge of the areas often flooded that are not caused by overflowing rivers. The model also simulated velocity flow, which defines the arrival time of peak flows, which can guide local actions for emergency response and preparedness.

- High-resolution elevation data from LiDAR. A critical input to the fine-scale flood hazard maps is the elevation data. Digital elevation models (DEMs) are needed to account for floodplain features like roads, buildings, and riverbanks, which have great effect on urban flooding. Airborne remote sensing LiDAR data made possible the acquisition of the high resolution digital elevation data representing topography, which were then processed on a geographic information system (GIS)-readable format suitable for fine-scale flood

modelling.

The project and its methodology to date are well documented and available in the project database in the documents “Climate Adjusted Flood Hazard Maps—Technical Annex” and “River Basin and Flood Modelling and Flood Hazard Assessment in the Rivers of the Cities of Cagayan de Oro and Iligan”. The resulting maps are also available in the database. An example is included in Figure 15.

The RAPID project builds on the work done by Programme Climate Twin Phoenix and aims to: 1) strengthen the institutional capacities of local governments; 2) mainstream climate change adaptation and disaster risk reduction and management in local development and land use plans and into the national policy framework. The RAPID project shall implement interventions to increase the knowledge and awareness of local governments and communities to effect change from “business-as-usual” to more sustainable development practices. It will promote community-level interventions, emphasizing on social inclusion, cultural diversity, and gender responsiveness. Partnerships with NGOs and academic institutions are also established to provide the program with wider reach.

Figure 15. Flood inundation map of Iligan and Mandulong Rivers (1 in 5 Year Rainfall Return, Year 2013).

9.5.7 Community Mapping for Disaster Risk Reduction and Management

Leading agency: The Department of the Interior and Local Government (DILG) has initiated various programs to support LGUs in Disaster Risk Reduction and Management (DRRM) and Climate Change Adaptation (CCA) planning and implementation. These programmes include issuing of instructions and guidelines on mainstreaming DRRM and CCA into local government systems and processes; forging partnerships with critical institutions and stakeholders; and prioritizing of LGUs that are high risk of flooding.

Description: As part of the Project the Environmental Science for Social Change (ESSC) Institute, Manila Observatory implemented a series of training activities on community mapping methods, using Open Street Maps (OSM). The training familiarized participants with OSM data and tools to enable them to produce a more robust municipal base map.

The project also used software based on the InaSAFE package developed by Indonesia's National Disaster Management Agency (BNPB) and the Australian Government, through the Australia-Indonesia Facility for Disaster Reduction (AIFDR) and the World Bank - Global Facility for Disaster Reduction and Recovery (World Bank-GFDRR)[g].

WebSAFE is the tool based on InaSAFE; it was developed by Project NOAH to meet the DRRM needs of the Philippines. It provides simple impact analysis through a webportal using the high-resolution hazard data on landslides, flood, and storm surge produced by Project NOAH technical experts.

The basic aim of this project was to empower communities to carry out their own hazard mapping work, which in the long term could be more effective than national initiatives, as they will be capable of adjusting it to local conditions and eventual changes, e.g., in the case of changes in natural resources due to the impacts of typhoons, earthquakes, flooding or other natural disasters. The process advocated by the project is included in Figure 16.

Figure 16. The process of community based risk management.

[g] InaSAFE is a free software package that produces realistic natural hazard impact scenarios for better planning, preparedness and response activities. InaSAFE provides a simple but rigorous way to combine data from scientists, local governments and communities to provide insights into the likely impacts of future disaster events. InaSAFE can be run on a standard desktop or laptop computer and does not require an Internet connection. http://inasafe.org/

9.5.8 FLOOD EARLY WARNING SYSTEM

Leading agency: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and partner local governments.

Description: Since 2007, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and partner local governments in Region 8 have accumulated experience and knowledge in the setting up and management of Local Flood Early Warning System (LFEWS). The programme, still active, proposes that human vulnerability and suffering could be reduced by monitoring sources of floods, predicting where and when floods could possibly happen, identifying who would be affected and strengthening the capacity of local disaster risk reduction and management institutions to make informed decisions.

Results: The first generation of GIZ-LFEWS was piloted in the Binahaan Watershed of Leyte Province in 2008. The system has since been replicated to seven other watersheds in Region 8. Since then, there have been observed impacts in terms of saving lives and properties, improving institutional performance of local governments and increasing public awareness.

The activities of GIZ and partners towards establishing LFEWS are well documented; the report "Local Flood Early Warning System" is available in the project's literature database.

9.5.9 MAINSTREAMING DISASTER RISK REDUCTION IN SUBNATIONAL DEVELOPMENT AND LAND USE/PHYSICAL PLANNING IN THE PHILIPPINES

Leading agency: This was an initiative carried out by the National Economic and Development Authority (NEDA).

Description: The National Economic and Development Authority developed a set of guidelines. The guidelines provide methodologies for risk estimation and valuation. These methods assess and quantify disaster event consequences (consequence analysis) in terms of fatalities or loss of lives and the cost of property. Indirect costs, however, have not been covered in this document and thus form one of the limitations of the risk assessment as considered and used in the Guidelines (NEDA, 2008).

Results: The project produced guidelines to estimate risk at local levels. The guidelines are available online, but it is unclear if they have been piloted or implemented anywhere in the country.

9.5.10 GEOPORTAL

Leading agency: The Geoportal project is managed by the National Mapping Authority (NAMRIA).

Description: The project is an attempt to centralise geospatial data. It advocates the use of standard multiscale base maps that serve as tools for strategic planning, decision-making,

situational analysis and other common requirements.

The portal consists of several applications including a map viewer, a catalogue a builder and specific topic map applications: Tourism, TD Plotter, Haiyan, Routing, Basic Services Provision, Map Composer and Disaster Risk Reduction and Management. In this latter the different maps from institutions producing natural hazard map are located.

It is an interesting proposition as it gathers all the mapping efforts under one platform. The DRM application is depicted in Figure 17.

Figure 17. Disaster Risk Management Application in Geoportal.

9.6 CONCLUSIONS FROM INFORMATION AND PROJECTS FOUND

Since 2000 there has been a number of projects that produced or are producing climate hazard or risk information, still some of them are using different methodologies which may result in data that is not comparable at different scales and for the same location. These different initiatives may produce conflicting data, which makes it difficult for decision makers to understand which is the most reliable data and what should they use to reduce the impacts of natural hazards in their communities.

From the survey and the interviews it seems that some projects have only produced localised data, despite their potential to be used in different places. According to the sample of respondents,

others have not reached those who could use the information, as not many potential users know about them (e.g. the Mapping Philippine Vulnerability to Environmental Disasters project, although one of the first comprehensive studies, does not seem to have had impact beyond academic publications).

The document Strengthening Disaster Risk Reduction in the Philippines: Strategic National Action Plan 2009-20 (GoP, 2009), also reflect the findings of this project:

"…Numerous projects and activities have been undertaken by various Philippine stakeholders. Some of these efforts have been valuable experiences for those who have been involved; however, sustaining the positive results have always been constantly threatened.

There are indications that these positive results have not simply penetrated day-to-day affairs or businesses. Old practices of doing things remain and existing organizational and societal structures do not allow the gains to thrive in the decision-making environment as well as operational setting…

…Threats remain if the level of awareness about dealing with hazards is low and when little focus on risks is considered whenever one is faced to make a decision…The message is that risk awareness must penetrate all levels of government, and in household, firms, and offices..." (GOP, 2009).

Almost twenty years have passed since the first assessment of DRM efforts in the Philippines by Benson (1997), the authors of the *Strengthening Disaster Risk Reduction in the Philippines: Strategic National Action Plan 2009-20* document do not differ in their findings, and neither does the team working in this project.

10 IDENTIFICATION OF POTENTIAL PROJECT INFORMATION PRODUCTS

Given the existence of projects, institutions and methodologies for mapping hazards in the Philippines, resources were used, not to produce another hazard map (as originally planned), but to identify information products that the project, or PAGASA, could produce in order to better assist economic sectors, Local Government Units and communities in their work towards disaster risk management.

Trying to answer common questions that decision makers tend to ask, the project team identified a preliminary set of products related to climate hazards/risks and climate change that could be useful in the Philippines.

The questions addressed basic climate variables and their change over time, hazard and risk, spanning across the different climate change projections (e.g. temperature changes, precipitation changes, sea level rise) and hazards (e.g. tropical storms, typhoons, flooding, storm surge).

Below are some of the examples of questions used to identify potential information products:

- Basic:
    - For a given emission scenario, for a given period (e.g. 5–10 year periods) how does temperature change by month, every 3 months, every 6 months?
    - What is the average sea surface temperature by 2020, 2040, 2050?
    - For specific time periods, are there more frequent heavy rainfall events? Does frequency of heavy rain change for these periods? How?
    - For a given period of time and a given season, how does humidity change compared to Normals?
- Basic Tropical cyclones (without impact)
    - How has the intensity of typhoons changed in the last 30, 60 years? Which are the areas most hit?
    - What is the probability that an event like Haiyan/Yolanda or larger happens in the next 10, 20, 30, etc. years? Where is this most likely to happen?
    - What are the most likely tracks and do they behave as they do currently? Do they look different under El Niño and La Niña conditions?
    - How could changes in intensity/frequency of typhoons change storm surge height?
    - How often are floods expected as a result of typhoons? Where?
- Tropical cyclones hazards
    - What is the probability of scategory 4, 5/super typhoon hitting highly urbanised cities within the next 25 and 50 years?
    - For a given period, how many times could a particular province be hit by a category 4 typhoon or above?
    - Which would be the areas most likely to be flooded? Or which areas would experience most recurrent inundation?
- Tropical cyclones risks
    - Which were the areas most hit by typhoons in the last 30 years? What is the distribution of costs of the impacts.
    - Would roads and bridges need to be built in a different way? What could be the impact of a change in frequency/intensity of tropical cyclones on roads?
    - What would be the impacts of tropical storm frequency/intensity on major cereal and cash crops for selected provinces? What would be the cost of not taking action?
    - High speed winds: how frequent and how strong could they become and what

would be the costs of damage to urban areas, rural areas and coastal and upland communities?

- Historical storm surge and affected areas: can it be derived from historical data or modelling for past 30 years? What have been the human and economic costs in affected areas?

- How can you show the impact of a 1 m, 2 m, 3 m, etc. surge to communities?

The questions above are just a few examples of common questions asked by decision makers; a wider set of questions were asked to guide the design of information products produced by this project.

More details on these questions and the potential usefulness of related products for a few sectors have been included in Annex VI. The project team expects to continue refining these products during pilot trials by consulting stakeholders from different economic sectors.

11 GAPS, OPPORTUNITIES AND GENERAL RECOMMENDATIONS

Gathering the findings from different stages, a number of gaps and opportunities have been identified. These are the basis for the recommendations being put forward by the team carrying out the work for WP2. These include:

1. While there are hazard/risk mapping efforts in the country, there is often a shortage of personnel to produce, analyse and transfer this information at all levels, but in particular, in the Local Government Units. There is an opportunity to identify mechanisms to improve the availability of personnel for these tasks. Also providing incentives for young people to become local meteorologists through, for example, climate field schools.

2. Information dissemination and outreach are a problem, given the lack of personnel and the lack of understanding of the needs of users. Until now, scientists and highly technical staff have been in charge of disseminating information. These often result in information that is not easily understood by non-specialists. There is an opportunity to create a culture of “user needs satisfaction” and train younger generations to write and deliver messages in a way that is better understood by the general public. Making stronger partnerships with the media and private sector may be part of a larger dissemination strategy.

3. It is often difficult for the general public to understand the magnitude of hazards. These could be improved if technical officers acquire better communication skills and ways to make sure that people picture the potential consequences of an upcoming climate event.

4. Agencies like PAGASA or the Mines and Geosciences Bureau do not have enough capacity to reach the 42,000 Barangays in the country directly, therefore more creative mechanisms need to be devised, perhaps using mobile phone alerts or social networks. The Philippine Atmospheric, Geophysical and Astronomical Services (PAGASA), for example, has a Facebook page, but pages for specific municipalities could be created, if

local meteorologists were available to maintain them. Also, PAGASA has an initiative working with farmers, called “climate field schools” that could be further used as a mechanism for hazard and risk information dissemination.

5. There is a need for more specific data for different economic sectors, but there is also the need to involve these sectors in the generation and analysis of climate hazards information and their impacts. It should not be the sole responsibility of PAGASA to generate this information. Mechanisms for involving both government agencies and the private sector within the different economic sectors should be found.

6. Data sharing has traditionally been a problem. It has improved recently among the Collective Strengthening on Community Awareness on Natural Disasters (CSCAND) Agencies, but hazard information needs to be made available and free for those who can make good use of it.

7. The results of interviews and the survey highlighted that there is also an urgent need to empower Local Government Units to produce and manage their own information, in order to reflect local conditions and help them plan better to reduce the impacts of climate and other natural hazards.

8. Some survey respondents indicated that national hazard maps often do not correspond to local conditions. There are opportunities to work directly with communities to map hazards more accurately and especially to train communities to update these maps. An important issue is that maps are good but they are static data, unless they can be updated regularly—communities are in a better position to do that. The problem is often the lack of capacity of Local Government Units, who do not have personnel that can map or understand mapping.

As part of a wider strategy to work towards more effective hazard information management (in the context of the project and beyond), the project team proposes the following:

1. To have a wider impact it is recommended not to embark on more hazard mapping, but to find ways of making the information that is already available reach the different stakeholders that need it.

2. Building capacity to “translate” existing information at different levels, including national, subnational and among different stakeholder categories. For example, choosing a set of people who could be trained to deliver messages and train others to do the same.

3. Complementing established initiatives, not embarking on new methodologies or mapping efforts. It is better to upscale what has been done already.

4. Making the data from this project available to the general public.

5. Using existing platforms for community outreach, e.g. climate field schools (PAGASA) or local mapping initiatives (for example, see Section 7.5.7).

6. Given their role in policymaking and their capacity to reach local governments, keeping The Department of the Interior and Local Government and The Office of Civil Defense engaged

in the project.

7. Working with a few Local Government Units to pilot information dissemination for specific audiences, e.g. selecting two or three pilot sites and a variety of economic sectors and community groups to work with.

8. Choosing pilot sites in areas less covered by international projects, e.g. outside Leyte (Tacloban).

9. Approaching other key stakeholders, such as the National Economic and Development Authority and the National Disaster Risk Reduction and Management Council, once the products are delineated, to widen the project outreach and the potential for its products to be used nationwide.

10. If mapping hazard/risk: It is better to build capacity for mapping, not to prepare maps; apply a climate change dimension to current methodologies (to those where it has not been considered); and choose other highly urbanised areas.

11. Carrying out a sector oriented analysis only if requested, as agencies seem to prefer doing their own work, and in partnership with the different sectors concerned. The project could, instead, contributing to further delineate which products could be useful for different economic sectors by engaging their representatives through pilot work.

REFERENCES

Amadore, L. A., 2011: Development of a Conceptual and Quantitative Typhoon Damage Model, NRCP Supported Project, National Research Council of the Philippines.

Amadore, L. A., J. F. Bucoy, S. D. Talib, and S. O. Yanga, 1985: Preliminary Typhoon Damage Scale in the Philippines. Joint AMS/PMS International Conference in Applied Meteorology and Climatology, 18–22, March 1985, Manila.

Asian Development Bank, 2013: Civil Society Briefs, Philippines. ADB, Manila. (http://www.adb.org/sites/default/files/publication/30174/csb-phi.pdf)

Bautista, M. L. P., B. Bautista, I.C. Narag, A.D. Aquino, K. Papiona, , A. L. Delos Santos, J. Nadua, J. P. Deximo, W. I. Sevilla, L. P. Melosantos, J. Bonita, R. A. Badilla, A. C. Duran, M. A. C. Monteverde, T. A. Cinco, F. D. Hilario, C. P. Celebre, A. Tuddao, E. Ares, O. T. Castro, L. B. Grafil, M. G. Ordonez, R. S. Umali, R. M. Barde, J. C. Felizardo, E. C. Hernandez, M. Jakab, G. Davies, W.C. Arthur, T. I. Allen, H. Ryu, M. A. Dunford, L. Peel, and A. T. Jones, 2014: Enhancing Risk Analysis Capacities for Flood, Tropical Cyclone Severe Wind and Earthquake for Greater Metro Manila Area: Summary Report. Republic of the Philippines and the Commonwealth of Australia (Geoscience Australia).

Brecht, H., S. Dasgupta, B. Laplante, S. Murray, and D. Wheeler, 2012: Sea-level rise and storm surges: High stakes for a small number of developing countries. *The Journal of Environment & Development*, **21**, 120–138.

Brown, N., L. A. Amadore, and E. C. Torrente, 1991: Philippines Country Study, in ADB, Disaster Mitigation in Asia and the Pacific. Manila. Asian Development Bank.

Climate Change Commission, 2012: National Framework Strategy on Climate Change 2010–2022. GOP, Manila.

GOP, 2009: Strengthening Disaster Risk Reduction in the Philippines: Strategic National Action Plan 2009-20.

GOP, 2015a: Official Gazette, Government of the Philippines (http://www.gov.ph/about/philippines/)

GOP, 2015b: Official Gazette, Government of the Philippines (http://www.gov.ph/about/gov/)

IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C. B., V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, and L. L. White (eds.)]. Cambridge

University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pp.

Jose, A. M., 1993: Climatological Information on Tropical Cyclones in the Philippines. Quezon City: Department of Science and Technology, Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), March.

Kreft, S., D. Eckstein, L. Junghans, C. Kerestan, and U. Hagen, 2015: Global Climate Risk Index 2015: Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2013 and 1994 to 2013. Germanwatch e.V.

Lansigana, F. P., W. L. Santos, and J. O. Coladilla, 2000: Agronomic impacts of climate variability on rice production in the Philippines. *Agriculture, Ecosystems and Environment*, **82**, 129–137.

Philippine NLUC, 1992: National Physical Framework Plan, 1993–2022. National Economic and Development Authority, National Land Use Committee, Manila.

Pineda, A. L., 1993: The Philippines: Common Haven of Natural Disasters. INCEDE Newsletter, 2(3), 1–4. University of Tokyo, Institute of Industrial Science, International Center for Disaster-Mitigation Engineering.

ANNEXES