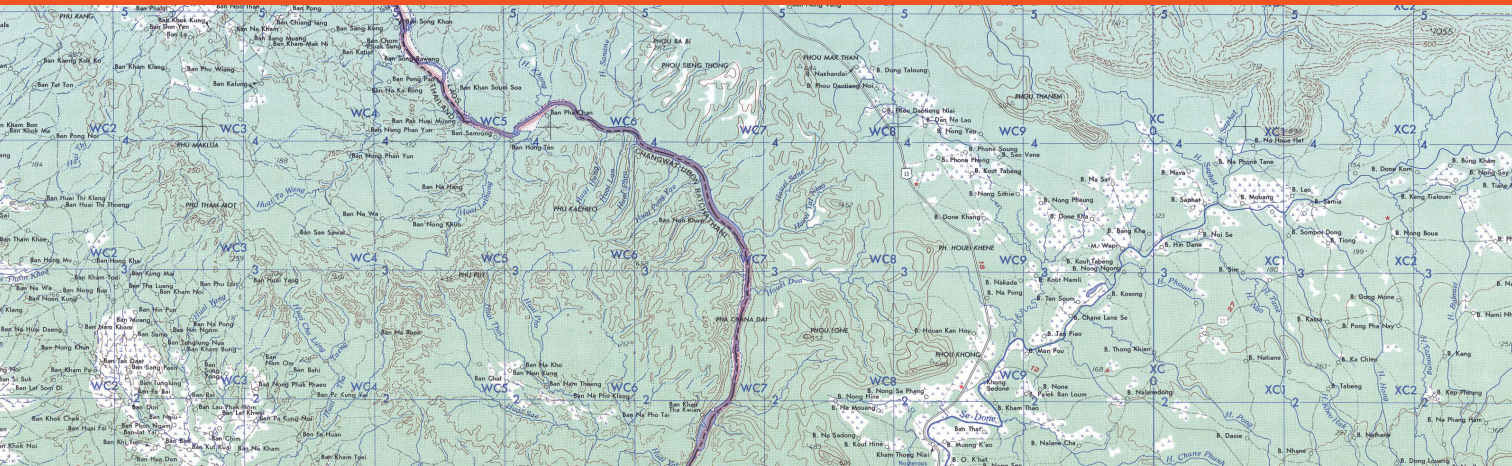


AN OVERVIEW OF

HAZARD MAPPING IN CAMBODIA



CURRENT STATE AND THE WAY FORWARD

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EXECUTIVE

SUMMARY

This report provides an overview of the hazard mapping resources and activities currently in existence in Cambodia, the main trends and potential focuses for the future.

Hazard mapping is a valuable risk assessment tool which is gaining increasing importance within Cambodia as a means of analyzing community resilience to disasters. However, little is known about the extent to which this is being used and how much information is available. Through the study of a number of online resources and interviews with key organizations involved with hazard mapping activities, this report summarizes some of the major organizations currently involved with hazard mapping and lists useful data sources available for those wishing to create hazard maps.

Analysis of these sources shows that there are many hazard maps being created in isolation and reveals trends such as the potential to be limited in focus, excluding key hazard elements which could be considered, and a lack of coherence between data sources, leading to difficulties with sharing of data. Despite the anticipated emergence of new hazard analysis tools developed for the National Committee for Disaster Management, it is still unclear to what extent these will be publicly available and how these will contribute to the overall development of standardization in hazard mapping across Cambodia.



Recommendations discussed include:

- **Filling hazard information gaps in a number of areas**
- **Enabling more effective sharing of hazard mapping data online**
- **Developing a more systematic process for data collection**
- **Advocating for open and unrestricted access to government data and tools**

ACRONYMS AND ABBREVIATIONS

AAC	ActionAid Cambodia
ADPC	Asian Disaster Preparedness Center
CamDi	Cambodia Disaster Loss Database
CCA	Climate Change Adaption
CReSIS	Center for Remote Sensing of the Ice Sheet
DCA-CA	Danish Church Aid- Cambodia
DRR	Disaster Risk Reduction
DIPECHO	Disaster Prevention European Commission
GIS	Geographic Information Systems
HRF	Humanitarian Response Forum
HVCA	Hazard Vulnerability Capacity Assessment
IOM	International Organization of Migration
MOWRAM	Ministry of Water Resources and Meteorology
MRC	Mekong River Commission
NAP	National Action Plan
NCDM	Nation Committee for Disaster Management
NGO	Non- Governmental Organization
ODC	Open Development Cambodia
OSM	Open Street Map
PCDM	Provincial Committee for Disaster Management
PHVCA	Participatory Hazard Vulnerability Capacity Assessment
PIN	People In Need
SEDAC	Socioeconomic Data and Applications Center
SNAP	Strategic National Action Plan
SCC	Save the Children - Cambodia
UNDP	United Nations Development Programme
VAM	Vulnerability Analysis and Mapping
WFP	World Food Program
WWF	World Wildlife Foundation

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INTRODUCTION

BACKGROUND

Cambodia is a country which is susceptible to numerous ongoing hazards. Considered one of the most disaster prone countries in South East Asia and ranked in the top ten countries most at risk of a disaster (Alliance Development

Works, 2013), its risks include annual hydrological events such as monsoon rains, flooding, and droughts. More recent changes in land use and mass urbanization, along with the underdevelopment of systematic water resource management practices and facilities, have led to a hazard rich environment. The effects of these hazards can be



PERCENTAGE OF HOUSEHOLDS AFFECTED BY NATURAL DISASTERS, CDB 2009

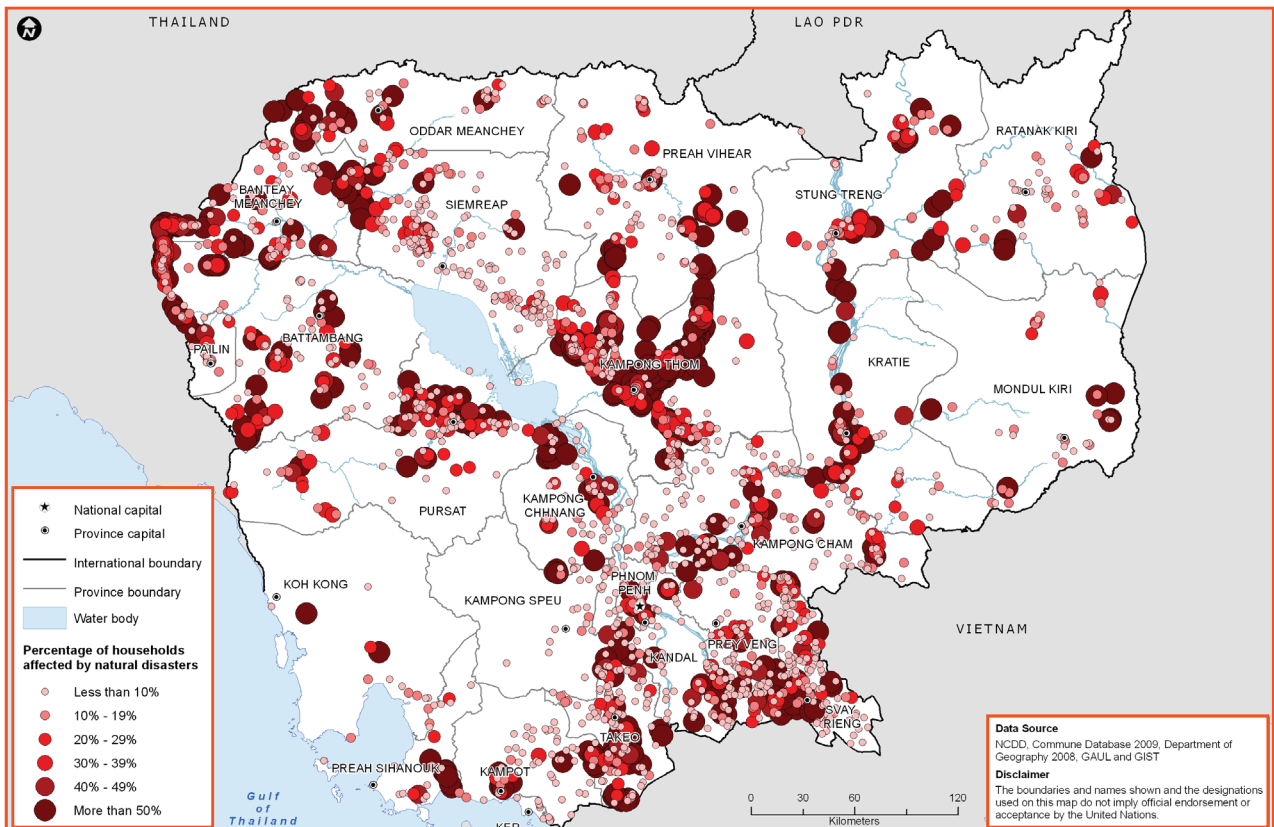


Figure 1

Many hazard maps exist which can be used to demonstrate areas at risk from disasters, but how easily available is this information? This map created by WFP shows concentrations of houses affected by natural disasters in 2009 and can only be found in a WFP database or through the HRF (World Food Programme, 2009).

extremely complex, but the use of data visualization tools such as hazard mapping allow for a more complete understanding of the risks associated with these hazards.

Hazard mapping and risk assessment form part of the foundation of a risk management decision making process, providing information essential to understanding the nature of the risks, hazards and vulnerabilities which a community might face. At its core, hazard mapping is the process of identifying and displaying the spatial variations of hazard events or physical conditions (Linda Noson, 2012) – such as low land and flooding, droughts with water access issues, wild fires with proximity to brush or forests – and displaying these in a visual way so people can understand them and assess the impacts that these events might have on a community.

Highly detailed, data rich geographical information related to hazards throughout Cambodia does not appear to be easily available. The government has noted in the National Action Plan (NAP) 2014-2018 that there is a need for a pragmatic shift toward activities which enhance resilience through the understanding of disaster risk reduction (DRR) and climate change adaptation (CCA), mentioning that one way to achieve this is through the further development of hazard maps and that using such maps for development

“ Hazard mapping and risk assessments form part of the foundation of a risk management decision making process. ”

and planning can help ensure better overall awareness (Royal Government of Cambodia, 2013). However, it is important to understand to what level hazards have already been identified and mapped in Cambodia and to what level this information is available to the general public, NGOs, and other stakeholders. In doing so, a better understanding of hazards can be achieved leading to a more robust and risk resilient community.

PURPOSE

People in Need (PIN) Cambodia has been working in the country since 2008, with a significant focus on disaster risk reduction and response. In 2013 PIN joined the DIPECHO 2012-2013 Consortium, replacing Concern Worldwide, PIN’s Alliance 2015 co-member, to partner directly with ActionAid Cambodia and Danish Church Aid. As part of this program, PIN is facilitating the creation of basic hazard maps based on information gathered from community Hazard Vulnerability Capacity Assessments (HVCA) along with the facilitating and sharing of this information through a simple, common and interactive tool —Google Earth. This information will

be shared with communities, members of the Provincial Committee for Disaster Management (PCDM) and other organizations involved with disaster response, with the hope that the data will create a clearer understanding of the base issues facing a community and lead to a strong foundation for contingency plans as part of the risk management process.

With this study, PIN intends to support these mapping activities by gaining a better understanding of the overall context of hazard mapping in Cambodia. Reviewing current activities will allow the consortium to identify approaches and gaps in information that could inform or complement its work, identifying further hazard mapping activities that could be beneficial to projects in Cambodia. Additionally, through the sharing of this information with all organizations in a concise format, it is hoped that this report will form a point of reference for the current context of hazard mapping in Cambodia in 2013. This information will allow organizations looking at hazards in Cambodia to better understand the overall current context of hazard mapping in Cambodia.

METHODOLOGY

This study is formed of several research steps, building upon a number of different resources to gain an overall understanding of hazard mapping in a humanitarian context within Cambodia.

Initial research focused on a number of major humanitarian resources available online to identify hazard mapping projects which have already occurred within Cambodia, beginning with websites such as ReliefWeb¹ and Prevention Web² and continuing to larger web search tools such as Google Scholar³. From this, each relevant resource, organization or project which offered publicly available information was examined in greater detail to provide an overview of the methodologies used, areas covered and issues faced. Interviews with key organizations were conducted to gain a deeper understanding of their activities. These interviews were also used to identify further organizations involved with hazard mapping who have not made their information available

online, who were subsequently contacted for further interviews. Direct interviews allowed a far deeper insight into the individual projects, particularly where no literature has been created regarding mapping activities, and allowed for topics such as lessons learned and challenges faced to be explored so a more comprehensive overview of hazard mapping in a Cambodia context could be accomplished.

Following this review of current and past mapping activities in Cambodia, sources were compared and analyzed together to identify any significant trends, potential gaps and areas which could be improved upon, with recommendations made for possible ways forward and areas which could merit further study.

This methodology and the timeframe of the study resulted in a number of limitations that should be noted.

- This methodology focused on information which could be attained using public information easily available over the internet and information which was given by word of mouth. As a result, information on organizations which have not shared their projects with the wider public, including private organizations, may not have been included in this report.
- Some information attained through interviews could potentially have been lost through the translation process, meaning that only a partial understanding of certain aspects of specific hazard mapping activities was achieved.
- The relatively short timeframe, combined with an emergency flood response taking place, limited the amount of time that key organizations could devote to providing information for this study, which potentially meant that only a superficial consideration of hazard mapping trends could take place.

¹ <http://reliefweb.int/>

² <http://www.preventionweb.net/english/>

³ <http://scholar.google.com/>



HAZARD MAPPING IN CAMBODIA

The research for this study focused largely on information which was either in the public domain or which could be attained by word of mouth and interviews. From the preliminary web based search and the subsequent interview process, a total of ten organizations were identified as having put together information related to hazard maps on Cambodia, with five organizations offering readily available information online and a further five

recommended via word of mouth. Another seven sources were identified as good resources for hazard-related information on Cambodia and the region of SE Asia. Some of these organizations offer publically available data for others to use to create their own maps – a key resource for any organization wishing to compile their own hazard maps – while others simply offer finalized maps created according to their own specifications.

ORGANIZATIONS AND HAZARD MAPPING

INTERNATIONAL ORGANIZATION OF MIGRATION (IOM)⁴

The IOM focuses its work on the movement of people within a region. In 2009-2010 IOM worked with communities in Mondulakiri, Ratanakiri, and Stung Treng to map the vulnerabilities of several of these communities, focusing its work on collecting data through interviews at both the governmental and non-governmental level along with conducting village based HVCA.⁵ Based on this information they were able to create risk indexes for key disasters that affect these communities and from this created several risk maps. In 2014 IOM is hoping to launch a new project that will look at climate change trends in Cambodia and how this impacts human migration trends. It is hoped that the outcomes of this data will lead to several maps and that reports on these trends will be able to be shared widely with the general public.



Figure 2 An example of a map created by a village in Pursat using the HVCA process. IOM would collect information from maps such as this and digitalize it as part of their HVCA hazard mapping process. (PIN, 2013)

⁴ <http://www.iom.int/cms/en/sites/iom/home/where-we-work/asia-and-the-pacific/cambodia.html>

⁵ Try Thuon; Kathlyn Kissy Maynes Sumaylo, 2009

Kathlyn Kissy Haynes Sumaylo, 2009

Kathlyn Kissy Haynes Sumaylo, 2010

■ ASIAN DISASTER PREPAREDNESS CENTER (ADPC)⁶

In 2010 the ADPC did a study looking at flooding in four provinces in Cambodia (Kampong Cham, Prey Veng, Kandal, and Phnom Penh). This study was based on flood information gathered from the 2000 floods and several impact maps were generated to simulate larger scale flooding which might occur in these provinces. The study discusses the methodology used to create flood hazard maps, though the actual data behind these maps are not available.⁷ ADPC is currently working in close coordination with the National Committee for Disaster Management (NCDM) to implement the final phase of their Ketsana program (April 2013- July 2014) and looks to collect vulnerability and capacity data, using this to map areas at risk. The Ketsana program was started in 2009 in response to Tropical Storm Ketsana which created massive flooding and damage as it passed through Cambodia. The program was developed to both help Cambodia recover from the effects of the storm along with assist governmental institutes such as NCDM prepare for the possibilities of future hazards. The current phase of this project has three focuses: to collect and map hazards, vulnerabilities, and capacity of Cambodia down to the commune

level by collecting data from PCDMs; to improve Cambodia's overall early warning system; and to create a data archive of all information related to the hazards vulnerability and capacity. Information from this project will be given to NCDM, who will have control over who is able to access this information.

■ UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)⁸

UNDP's overall aim is to support Cambodia to achieve its Millennium Development Goals. Its main focus areas include: the diversification of growth and the translation of growth into the reduction of poverty and inequalities in rural areas; sustainable and participatory management of natural resources that represent primary assets for the poor (including oil and gas, arable land, forestry and fisheries); and strengthening participatory democracy and good governance. As part of this, UNDP is developing the Cambodia Disaster Loss Database (CamDi) system, a database aimed at strengthening national capacities for monitoring and analyzing disasters and their impacts based on past disaster loss data. This system has information at all levels down to commune level, including data on human and financial loss and the impacts from hazards dating back to 1996. UNDP

also has an interactive map application that allows CamDi users to visualize the data. The CamDi system should be operational by the end of 2013 and should have the ability to export direct data of losses for future hazard mapping projects.

■ OPEN DEVELOPMENT CAMBODIA (ODC)⁹

ODC offers a function driven website, established with the goal of making data and materials available to all users in order to facilitate stronger communication between the public, private and development sectors. It has an interactive map which allows a user to visualize data about topics which affect Cambodia such as land and mining concessions, census data and natural resource management, among others. Though not created with a hazard mapping purpose in mind, the information shared through the ODC site could be very useful for any organization looking at doing hazard mapping. ODC focuses on sharing data that is already in the public domain. In addition ODC allows users to download its map-based information in multiple user accessible formats including .jpg, .pdf, and shapefiles, enabling other organizations to use this data to create their own maps.

■ HUMANITARIAN RESPONSE FORUM (HRF)

The HRF is a combination of humanitarian actors (UN and NGOs) which meet routinely, focusing on strengthening emergency preparedness and response

“ UNDP is developing the Cambodian Disaster Loss Database, a database aimed at strengthening national capacity for monitoring and analyzing disaster. ”

⁶ <http://www.adpc.net/2012/>

⁷ http://www.academia.edu/3195334/Flood_hazard_mapping_in_four_provinces_of_cambodia_under_the_Mekong_Basin

⁸ http://www.kh.undp.org/content/cambodia/en/home/operations/about_undp.html

⁹ <http://www.opendevolucioncambodia.net/>

with the goal of enhancing overall coordination and communication among humanitarian organizations in Cambodia. The HRF shares maps produced by World Food Program (WFP), Vulnerability Analysis and Mapping (VAM) and other humanitarian actors through its DropBox. The maps themselves are in PDF format and many can be accessed through Relief Web. For maps not available on Relief Web, access to the HRF's DropBox can currently be arranged by contacting the HRF¹⁰. The DropBox has a growing archive of humanitarian related maps dating back to 2008 available through its Maps folder.

■ SAVE THE CHILDREN-CAMBODIA (SCC)¹¹

Save the Children Cambodia has a large presence in Cambodia working directly with government and local ministries, other civil societies, and research organizations in 13 provinces. Their programs are largely child focused, aiming to improve the development of children, and range from education based programs to protection issues and emergency response. They commonly use map-based information throughout their projects both for data visualization and to gain situational awareness. Recently they have been developing their ability to do GIS-based mapping and keeping track of map-based information using an internal database. Throughout its education programs SCC has been implementing DRR and CCA projects.

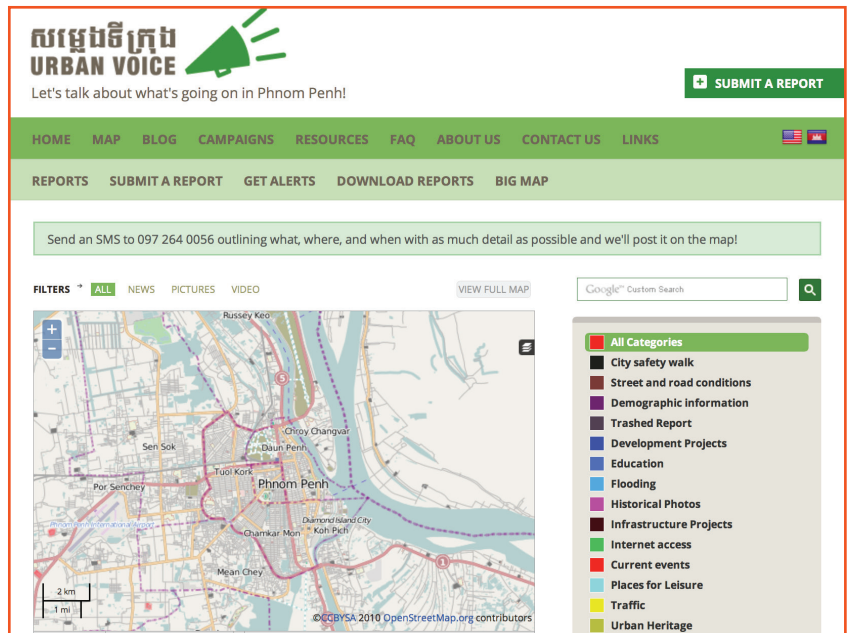


Figure 3 An example of the mapping resource that Urban Voice uses to illustrate information about Phnom Penh. (Urban Voice, 2013).

■ WORLD FOOD PROGRAM (WFP)¹² AND VULNERABILITY ANALYSIS AND MAPPING (VAM)¹³

As one of WFP's programs in Cambodia, the VAM team's main goal is to illustrate nutrition, poverty and food security issues as they relate to WFP programs in Cambodia. In addition to its main task, VAM plays a supporting role for all UN agencies in the country, helping these agencies generate map-based information for their individual projects. It also helped to develop the flood hazard and drought hazard maps used by the National for Committee Disaster Management (NCDM) in their Strategic National Action Plan (SNAP) 2008-2013 (UNISDR B. G., 2011). It has access to

a large, well-established inventory of base level maps and is a good point of reference for tracking down specific information related to a particular event or risk which might affect a region. VAM creates and shares many of its maps in PDF format, which are publicly available through Relief Web, UN agencies, or through the HRF.

■ URBAN VOICE¹⁴

Urban Voice is an open, contributor-based website which creates visualizations of development in the Phnom Penh area through a map-based program. The Urban Voice map uses the Ushahidi crowd-sourcing application to allow anyone who wants to

¹⁰ gianpietr.bordignon@wfp.org or caroline.mccausland@actionaid.org

¹¹ <http://cambodia.savethechildren.net/>

¹² <http://www.wfp.org/countries/cambodia>

¹³ <http://vam.wfp.org/>

¹⁴ <http://www.urbanvoicecambodia.net/>

contribute to submit up-to-date information for the map. It has a large range of topics from urban flood issues to urban heritage and many more. The map allows the user to zoom into specific regions of Phnom Penh, visualize particular topics and events, read reports associated with events, and view this all through a timeline. Urban Voice has close ties with the NGO Sahmakum Teang Tnaut (STT)¹⁵ which works with poorer urban communities to provide them with technical assistance on issues related to housing and infrastructure, along with advocating and raising awareness about urban issues in and around the Phnom Penh area.

■ MEKONG RIVER COMMISSION (MRC)¹⁶

MRC is an inter-governmental agency that works directly with the governments of Cambodia, Lao PDR, Thailand and Vietnam on the joint management of shared water resources and the sustainable development of the Mekong River. MRC has a large amount of map-based hydrological data on the Mekong River and Tonle Sap available through their website. Low resolution images of particular regions along the Mekong and Tonle Sap can be downloaded for free, while high-end data-rich maps can be purchased through the website. Several time series maps related to precipitation, river water levels, and hydrological events are also available for download.

■ THE MINISTRY OF WATER RESOURCES AND METEOROLOGY (MOWRAM)¹⁷

MOWRAM is a Cambodian governmental agency setup to monitor climatic events throughout the country. When there is a risk of an event impacting the population of a particular province, MOWRAM will issue a warning. These warnings can be viewed on their website through a very basic countrywide risk map which shows which provinces should expect what type of meteorological events to impact them.

ADDITIONAL SOURCES OF DATA

■ DIVA-GIS¹⁸ AND ADMINISTRATIVE BOUNDARIES¹⁹

DIVA-GIS and Administrative Boundaries are free websites which allow the user to download geo-referenced data, shapefiles and .kmz files. One of the most useful features is their ability to sort information based on country. Both have a large amount of downloadable files on Cambodia, including base shapefiles of administrative areas, waterways, roads, rail, population, elevation, along with a gazetteer of different cities in .xml format.

■ ASIA POP²⁰

Asia Pop is a newer website that allows users to download high resolution

geo-tiff images related to population density in Southeast Asian countries, including Cambodia. They are also developing similar maps that will deal with topics of age, gender, population growth, and human mobility.

■ OPEN STREET MAP (OSM)²¹

OSM is “collaborative project” which was set up to create a free and editable map of the entire world. Information on OSM is gathered by over 1 million users through GPS, phones, or other geocollection devices and then shared with the public. These maps are routinely updated and at times can be of better quality than many other sources. Open StreetMap.la is a website that allows users to download OSM files that pertain specially to Cambodia and Laos.²²

■ DARTMOUTH UNIVERSITY²³

In 2009 Dartmouth University put together a global flood map representing historic flood data from 1993 to 2009 in detail. In this they were able to map flooding data in Southeast Asia from 2002 to 2009. These maps show a comprehensive overview of flooding that took place in Cambodia over that timeframe, which could be used to visualize areas that have been susceptible to flooding in the past. Their website also features several additional visualization tools that can be used to look at both individual flood maps and global flooding²⁴. Access to the data behind the information does not appear to be available.

¹⁵ <http://teangtnaut.org/>

¹⁶ <http://www.mrcmekong.org/>

¹⁷ <http://www.cambodiameteo.com/map?menu=3&lang=en>

¹⁸ <http://www.diva-gis.org/gdata>

¹⁹ <http://www.gadm.org/country>

²⁰ http://www.andytatem.webspace.virginmedia.com/index_files/AsiaPop.htm

²¹ <http://www.openstreetmap.la/files/cambodia/>

²² <http://openstreetmap.la/>

²³ <http://www.dartmouth.edu/~floods/hydrography/E100N20.htm>

²⁴ <http://floodobservatory.colorado.edu/index.html>

■ CENTER FOR REMOTE SENSING OF ICE SHEETS (CRESES)²⁵

CRESES has put together a map charting the rise of global sea levels, which includes a downloadable map of south-east Asia. This can be downloaded

in .pdf or .jpg format for use by groups looking to study the impact of sea level coastal inundation.

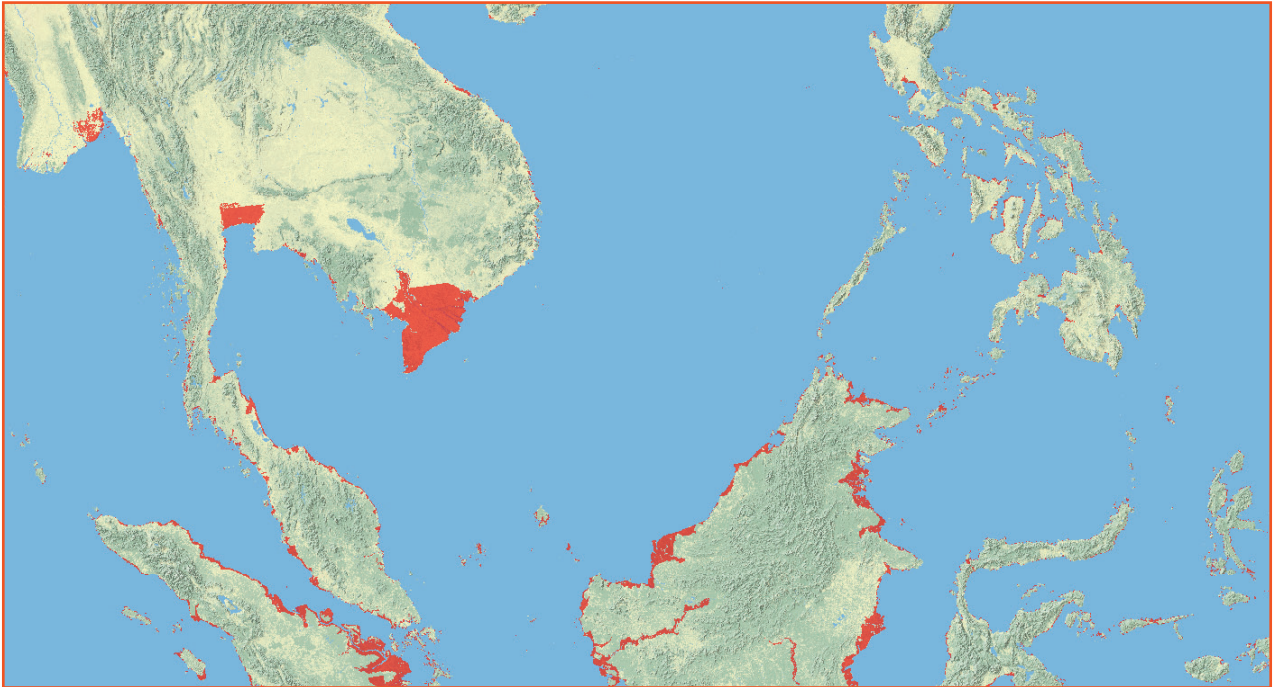


Figure 4 An example of one of the many maps available on the CRESES website. This one demonstrates the effects of sea level rise in SE Asia should sea level go up 5m (Center for Remote Sensing of Ice Sheets, 2013).

■ SOCIOECONOMIC DATA AND APPLICATIONS CENTER (SEDAC)²⁶

SEDAC is a data and application center set up by NASA. Its goal is to act as an information gateway which links topics related to social sciences and earth sciences. In doing this there are many linkages in different data sets which can be used for hazard mapping.

■ WORLD WILDLIFE FOUNDATIONS (WWF), CONSERVATION SCIENCE DATA AND TOOLS²⁷

WWF's Conservation Science Data and Tools website allows a user to access information related to biodiversity and natural habitats around the globe. Its information can be used to look at both hydrological and biodiversity related

information. This information could potentially be used to create risk models which so a better understanding of hazards can be attained.

²⁵ <https://www.cresis.ku.edu/>

²⁶ <http://sedac.ciesin.columbia.edu/>

²⁷ <http://worldwildlife.org/pages/conservation-science-data-and-tools>



ANALYSIS OF CURRENT TRENDS

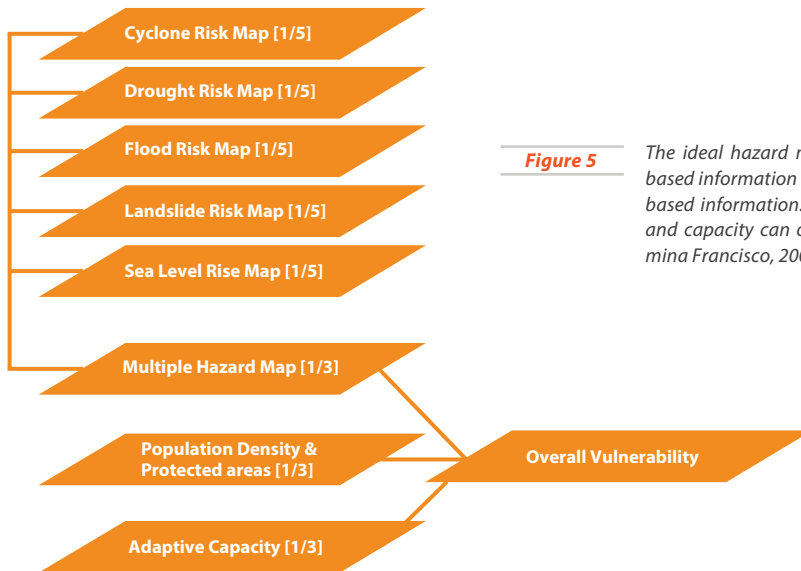


Figure 5

The ideal hazard mapping system should be made up of map-based information on particular hazards overlaid with population based information. Additional information such as vulnerability and capacity can only enhance results. (Anshory Yusuf and Hermina Francisco, 2009)

Despite the existence of hazard mapping information in a number of formats from a variety of organizations, study of these shows that there is little coherence or standardization within the hazard maps currently available in Cambodia.

Organizations tend to create these maps on an ad hoc basis, focusing on topics and regions related to their current and specific priorities with mapping tending to be a means to an end rather than the aim of the project. While useful for specific projects, when considering hazard mapping as a whole, this approach leads to a number of

limitations and suggests some interesting points for consideration in the context of hazard mapping within individual organizations and some of the new systems currently being developed.

Hazard maps created for specific projects tend to be rather limited, focusing solely on the regions or topics specified in the project outline. It is evident that many organizations – such as Save the Children, World Food Program and the Mekong River Commission – have been using maps to inform many aspects of their work. However, hazards themselves are

very rarely contained within a boundary imposed by humans, such as specific commune borders or project areas. This could suggest that specific hazard maps developed in isolation could only represent a portion of the overall picture—both in terms of those affected by a particular hazard and the wider hazards that could impact the specified area.

Wider mapping resources which cover larger areas tend to focus on only a few aspects relevant to hazard mapping, which mean that vital connections could be overlooked. There are many web based data resources available which share information on Cambodia, yet very few of these websites are Cambodia-based and almost none of them currently sync with each other, making it difficult to use the information from these sites to generate hazard maps. Generally data from international

sources focuses on one specific topic, such as population demographics (Asian Pop) or sea level rise (CReSIS). It is only through cross-referencing the information from two sites that an understanding of the full potential impacts of sea level rise on the coastal regions of Cambodia can be gained. To create a fully operational hazard map, hazards themselves need to be able to be visualized in a system that shows what their impact might be on a population, as illustrated in Figure 5.

The issue with cross-referencing information from different sources is that data is rarely provided in the same format. International sites may share data in any number of proprietary formats from a basic visual map to an interactive database, with many being unusable except as a reference tool. Within Cambodia, base level information is different from project to project, as each organization collects their own information from the base level up in their own way. This makes the sharing of this information very difficult, as very rarely are multiple sets of data in a format that is both truly comparable and shareable. To amalgamate information from many sources to cover a wider area would be impractical as the hazard maps would not be comparing the same basic information.

Open Development Cambodia (ODC) is attempting to address this problem by collecting many types of information and using an interactive, layered map to share this with the public. While information from external websites is not always fully comparable as it is not necessarily in the same format, this tool makes both the data source and the visual accessible to the general public

“ Within Cambodia, base level information is different from project to project. ”

and allows the user to visualize the information on one map. However, in terms of hazard mapping, ODC has its limitations as their overall purpose is broader than natural and man-made hazards, spanning all topics related to economic and social development in Cambodia. In the current version of ODC specific hazard-based information could be easily overlooked among the wider economic issues illustrated. This makes the ODC website a good resource for base level information but not a complete hazard mapping application for Cambodia.

The hazard mapping portions of two of the projects being developed for NCDM – UNDP’s CamDi and ADPC’s Ketsana program – have the ambition to tackle a portion of these issues and could potentially lead to a more systematic process for data collection. However, these projects do have a number of limitations in terms of scope and format which could affect the hazard maps produced.

Both CamDi and the Ketsana program only look at information down to commune level, running the risk of vital information being overlooked. A limitation of only working to commune level is that communes can vary greatly in size and can contain diverse geological features within a relatively small boundary, with plains, mountain, rivers and coastlines all occurring in the same commune. This runs the risk of leaving out important information by generalizing a commune as having only

one particular type of geology and therefore only being susceptible to a particular type of hazard.

The CamDi system only takes into consideration loss related information over a short span of time dating back to 1996. Many individual communities and villages already have institutional knowledge that far exceeds this level of information, yet because the system does not go down to the village level it will not gather this. One method developed to combat the information gap from commune down to village level is the HVCA and PHVCA methodology, which has been endorsed by NCDM and is used both by IOM and the AAC, DCA-CA and PIN DIPECHO Consortium for their hazard maps. In this communities are asked to recall and document historic events which have had an impact on them in the past; combining HVCA’s with the CamDi system could help to overcome these time limitations.

Despite the benefits of using HVCA’s to understand historic hazards at community level, solely using this type of information for standalone hazard analysis can still be limiting, as the knowledge gathered tends to only goes back as far as eldest member of the community. This could suggest that hazards which occur very rarely could be omitted from the recorded hazard list, even though they might pose a significant risk to a community. Additionally, information gathered through this type of analysis does not normally

take into consideration new hazards created through rapid development of the region over the last several decades. This could mean new risks which are currently emerging and could potentially be hazardous to a community might not be taken into consideration in the HVCA or PHVCA process.

The hazard maps being developed as part of ADPC's Ketsana program appear to have the goal of looking at some of the wider development related risks in a Cambodia context. However, while this and CamDi aim to create a more systematic process of data collection, as of yet neither seem to be focusing their work outside the borders of the country. Therefore, both could be seen as incomplete hazard data sources as they do not take into account external elements which could impact communities within Cambodia, such as dammed rivers in neighboring countries. This runs the risk of leaving out vital information which is important for creating a full picture of the hazards affecting Cambodia.

An important point to bear in mind regarding both these programs for NCDM is that the information which they will be provided is new and as yet untested. It is therefore understandable that the extent to which the public will be able to access the information has not yet been fully clarified by NCDM. UNDP says that NCDM will be sharing all the information that CamDi has to offer with other organizations, however until the project has been made publicly available this is not a resource that those

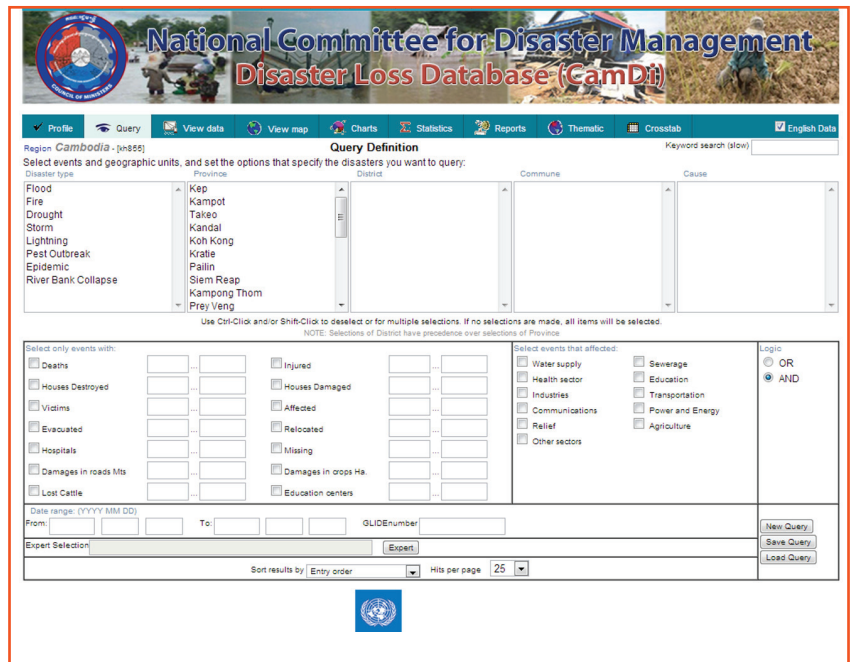


Figure 6 An example of search functionality for the CamDi system. CamDi is a database setup to examine historic disaster loss data throughout Cambodia. (CamDi, 2013)

looking to develop hazard maps in Cambodia can rely upon. Control by NCDM could mean that the information collected and stored in both the CamDi and the ADPC system might not be shared with the wider public or is difficult to access, meaning the information stored in these systems will have a very limited overall impact on the development of hazard maps in Cambodia.

The collection and storage of information on NCDM's systems offers the opportunity to collate data in a particular systematic format and to standardize data formats for hazard map creation among the many organizations

already producing these. Hazard information requires constant updating as human and geological situations change, so it would be highly beneficial for all organizations working in this field in Cambodia to be able to have input into NCDM's data and to access information gathered by others. If access to information from the CamDi and Ketsana programs is shared with other humanitarian actors in a usable format, NCDM would have the opportunity to develop a unified data collection methodology in Cambodia which could greatly impact the efficiency and effectiveness of overall hazard mapping in the future.



RECOMMENDATIONS

FILL GAPS IN HAZARD KNOWLEDGE

Gaps in information seem to exist in three main areas related to hazards in Cambodia:

- Hazards that could impact the whole region of SE Asia and Cambodia
- Hazards which are created through rapid development in the country and region (mass urbanization, underdevelopment of systematic water resource management practices, etc.)
- Hazards whose occurrence is very rare and might not even be considered as hazards due to insufficient institutional knowledge of them (industrial accidents, large tidal bore, tsunamis, etc.).

By filling these gaps with a database of the information related to these topics, hazard maps could be created which would potentially lead to a better understanding of risks in the region. In doing so, data sets on these topics could shed a lot of light on the overall risks which current hazard maps may not fully take into account.

UNIFIED HAZARD MAPPING SYSTEM

The information gathered for this study was only able to focus on evidence which was either in the public domain or information which had been shared with other organizations. As there may be other organizations which lack the capacity or resources to share their information more widely, it could be beneficial to encourage the sharing of hazard related information. A simple way to achieve this could be to create a common website that is open to all where information can be shared publicly. Creating an easily accessible website would allow all organizations which are monitoring hazard related information to share their information and the projects with the greater

public. One way this might be easily achieved could be to work in close coordination with ODC to create a hazard mapping tool for their interactive system. Because of the open nature of ODC, in which it gathers information from external public sites onto their database and shares this with the public in one format, building upon the use of this tool could be an opportunity to increase sharing of hazard related information and create a very useful, publicly available tool for visualizing hazards.

UNLIMITED ACCESS TO HAZARD MAPPING DATA

The upcoming release of the CamDi system and the development of the ADPC hazard mapping project should

technically allow all organizations that are given access to these resources a clearer understanding of the possibilities that information on past trends, hazards, vulnerabilities, and risk could have. As both of these systems are being newly developed for NCDM it is understandable that they may want to control access to the data during the initial implementation phases; however as these programs further develop it would be beneficial for this information to be more widely available. There are many benefits to the public having unrestricted access to this data, both in terms of organizations benefitting from this information and those performing future hazard mapping activities being able to include a variety of accurate and up-to-date data. With this in mind, humanitarian actors should advocate for the open and unrestricted use of these tools.

SYSTEMATIC DATA COLLECTION PROCESSES

One of the major issues identified through this research was the lack of a coherent country-wide systematic process for data collection. Organizations need to be able to compare similar data in an analogous format otherwise there can be a disconnect in terms of the assessments made and the conclusions

drawn. However, in order for this to be possible, there is a need for standardized data collection guidelines and universally accepted methods of achieving this. These new systems being developed for NCDM offer an opportunity to create a truly open, user driven systematic process for all hazard-related data capture. Through the unlimited sharing of hazard-related information, NCDM would also have the opportunity to keep their data

updated through the active participation of related organizations whose information could be fed back into the system. In doing this there is a potential for creating one concise format to share hazard information which could have a large impact on the humanitarian sector, resulting in an increase in all agencies' efficiency and overall knowledge of hazards in the region.

CONCLUSION

Cambodia is a country which is highly susceptible to disasters. The Royal Government of Cambodia has fully acknowledged the need for a pragmatic shift toward activities which enhance resilience through the understanding of DRR and Climate Change Adaption, with hazard maps acknowledged as one key way to visualize this. However, despite a number of hazard mapping activities being carried out across the country, it appears these have largely been put together on an ad hoc basis by individual organizations as part of wider project activities, which has resulted in little unification or coordination between these. Two projects, both commissioned by the government, do seek to address the need for a more comprehensive process of viewing and analyzing disaster information, by dis-

playing historic loss-related data – through the CamDi system developed by UNDP – or presenting hazard-related data collected over the next year – as part of the ADPC's Ketsana program. Although both these systems are great steps towards demonstrating the need for a systematic process of data collection, both seem to have gaps which in the end may prevent them from being able to be used as standalone hazard mapping tools as their individual specific focuses mean some key data is not included. The most effective way forward for Cambodian hazard mapping would be to create one openly available online platform with a data visualization component which combines both archived data from tools such as CamDi, the vulnerability and capacity information collected by ADPC's Ketsana program, additional inputs from organizations

working across the country and external sources of information about the SE Asia region. Similar hazard mapping projects are being run in other countries, such as local flooding impact mapping systems used by the Environment Agency in the UK²⁸ or the development of multi-hazard mapping by FEMA in the USA²⁹. However, until such a time as this is possible in Cambodia, if these tools for the government and the data they represent are made accessible to the public, this will signify a very positive step forward for hazard mapping in Cambodia. Nevertheless, further work is still needed to develop universally accepted processes for gathering hazard-related data and create one standardized hazard-related information sharing system which can be accessed and updated by all involved with hazard mapping.

²⁸ <http://www.environment-agency.gov.uk/homeandleisure/37837.aspx>

²⁹ <http://www.fema.gov/risk-mapping-assessment-planning>

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