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Assessing Gaps and Strengthening Early Warning System to Manage Disasters in Cambodia

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Abstract Many organizations and centers throughout the world are involved in providing early warning information in terms of hazard related issues. Most of them focus on storms and floods, drought, cyclones, etc. In order to reduce the impacts of these events, early warning systems play a vital role for preparedness, response and emergency management. Although early warning systems exist in different countries, they require monitoring and review from time to time to keep the systems updated. In this paper, we present an assessment of the gaps in existing early warning system in Cambodia so as to strengthen the system to make it more effective for disaster mitigation. The gap assessment was conducted from the national to the commune level through interviews and focus group discussions based on questionnaires developed for understanding the linkages within early warning systems as well as the linkages between national, provincial, district and commune committees for disaster management.

Key Words Early warning systems; Hazards; Gaps assessment; Disaster management; Cambodia

1. INTRODUCTION

In any country whether developed or developing, there has always been a concern about the huge impacts that natural disasters may cause to society. Although several initiatives have been undertaken by countries affected by or prone to disasters, yet it is seen that societies have not adapted their frameworks of development to the natural environment surrounding them and the losses and costs associated with disasters of natural origin. On the contrary, societal catastrophes are growing by the decade with statistics suggesting that global annual disaster losses are on the rise.

While some material losses seem to be unavoidable, especially in the case of very large and infrequent events, in some cases the loss of human lives could be avoided if the proper precautions and measures had been in place. This would have been the case for the December 26, 2004 Indian Ocean tsunami, which provoked fatalities surpassing a quarter of a million people. The tsunami took a toll of 34,000 people in Sri Lanka alone due to lack of an early warning system (EWS) which would have otherwise significantly reduced the loss of lives had there been an EWS put in place.

Cambodia is one of the five countries located along the Mekong River, and its landscape consists of rolling plains and lowland (Leng 2014). During the monsoon season, Cambodia experiences flash floods

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usually after heavy rainfall. Droughts in Cambodia are mostly characterized by water loss caused by the early end or delays in expected seasonal rainfall severely affecting the farming community. Specifically rice cultivation and livestock are most affected.

The 2011 floods in Cambodia affected 350,000 households of over 1.5 million people and 52,000 households had been evacuated. 18 out of 24 provinces in were affected of which 4 provinces along the Mekong River and Tonle Sap were worst hit. 250 people lost their lives and 23 people sustained injuries. 431,000 hectares of transplanted rice fields were affected and 267,000 hectares of rice fields were damaged (Leng 2014). Furthermore, Cambodian floods of 2013, affected 20 out of 24 provinces, 377,354 households, claimed 168 lives, and forced 31,314 households to evacuate themselves to safer areas. Droughts have also had severe impacts. The drought in 2011 affected 14,190 hectares of rice fields, completely destroying 3,151 hectares of rice fields.

Considering the country's exposure to frequent natural disasters, Cambodia under its programme on Ketsana Emergency Reconstruction and Rehabilitation Project (KERRP) post Ketsana Typhoon 2009, funded by the World Bank has decided to conduct a study on the institutional strengthening and capacity building of National Committee for Disaster Management (NCDM) in the country. The objective of the study was to conduct a detailed review of Cambodia's existing early warning systems and understanding their gaps from the national to the commune level. Considering Asian Disaster Preparedness Center (ADPC)'s experience in the Southeast Asia and the Pacific in Disaster Risk Reduction (DRR) and Climate Risk Management (CRM), the National Committee for Disaster Management (NCDM) in Cambodia requested ADPC to conduct this study on understanding the gaps in existing early warning systems and developing an end-to-end approach of operating the systems from national to commune levels.

In this paper, we present an assessment of the gaps in the existing early warning system in Cambodia so as to strengthen the system to make it more effective for disaster mitigation. The gap assessment was conducted from the national to the commune level through interviews and focus group discussions based on questionnaires developed for understanding the linkages within early warning systems as well as the linkages between national, provincial, district and commune committees for disaster management.

1.1 Status of Early Warning Systems in Cambodia

According to the United Nations International Strategy for Disaster Reduction (UNISDR), an early warning system is the set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by hazards to take necessary preparedness measures and act appropriately with sufficient time to reduce the possibility of harm or losses (UNISDR 2009). This definition encompasses the range of factors necessary to achieve timely warnings for effective response. A people-centered early warning system necessarily comprises four key elements: risk knowledge; monitoring and warning services; dissemination and communications; and response capability (UNISDR 2009; Phaiju *et al.* 2010) (Figure 1).

An extensive review conducted by a team of experts from the Asian Disaster Preparedness Center (ADPC) found that the Ministry of Water Resources and Meteorology (MOWRAM) is mandated to produce and disseminate forecasts for the entire country. Flood monitoring, forecasting and warning information on the Mekong, the Bassac and the Tonle Sap mainstreams is disseminated by the MOWRAM and the Department of Hydrology and River Works (DHRW). They disseminate information through daily bulletins, emails and faxes to relevant line agencies, to be disseminated further to the public by radio, newspapers and public media networks.

ADPC organized consultation meetings with officials and staffs of MOWRAM. The outcome of the discussions suggest that MOWRAM along with its branch Department of Meteorology is responsible for monitoring the weather conditions in the country and region; for issuing weather forecasts and providing

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warnings on weather conditions to relevant agencies, including the NCDM, by phone, fax, email, web page, TV/radio, newspaper and SMS. However, the warning information is still limited - for example, locations vulnerable to the events are not specified. The Provincial Department of Water Resources and Meteorology (PDOWRAM) at the local level further disseminates the warnings to communities (communes) through its networks by phone and radio-communication.

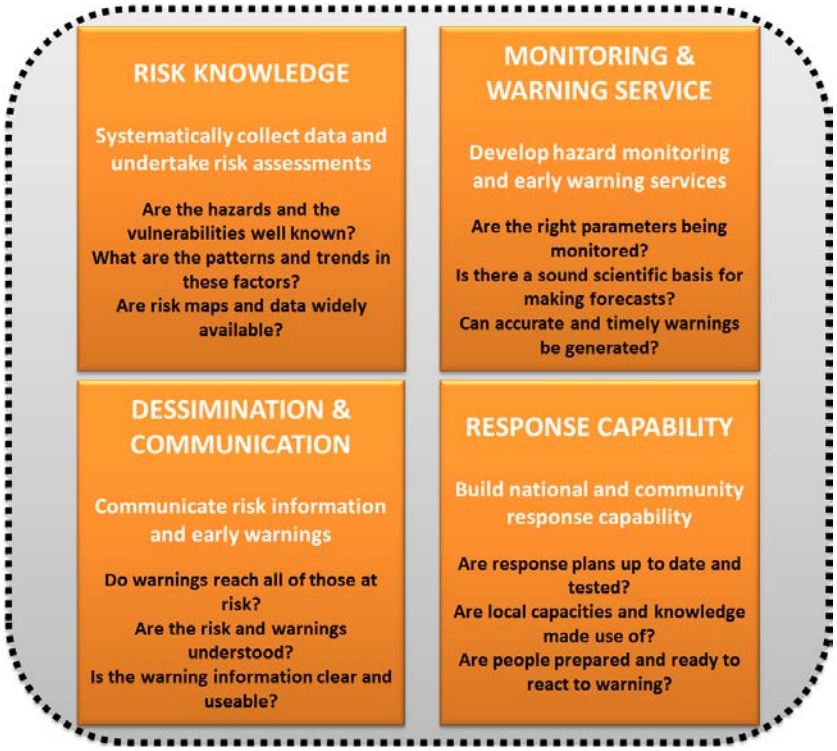

Figure 1. Four elements of early warning system (UNISDR 2009)

The review of information also shows that Cambodia's early warning systems are in place but at the same time also highlighted the needs to conduct assessments considering the limited capacity of MOWRAM as well as lack of sufficient funding, outdated communication systems, and lack of equipment. Furthermore, the coordination between MOWRAM and NCDM was found to be weak as NCDM uses its own network from national to commune level to disseminate warnings. Barriers to information dissemination are also related to low capacity knowledge about warning information, communication devices, transportation, and use of advanced forecasting models and tools.

1.2 Preparedness Capacity in Cambodia

Although preparedness capacities exist in Cambodia, the unpredictability and increasing severity of extreme weather events clearly require significant improvement in the capacity for early warning and preparedness. Strengthening the capacity to anticipate and prepare for disasters is critical to ensure that these events do not engulf people's ability and do not make them suffer from the aftermath. Anticipating disasters also involves warning and preparedness at the individual and institutional level. Preparedness includes monitoring of hazards and dissemination of risk information and warning, having emergency plans and accessible evacuation information. The purpose of early warning is to give people time to evacuate during extreme weather events. It also enables local authorities to evacuate or shelter large

numbers of people in advance; provide information on the occurrence of a public health hazard; and enable a faster response to problems of food and water insecurity. Warnings issued well before an event would enable people to take precaution, protect some property and infrastructures. Local authorities could activate their emergency response mechanisms; aid agencies can get sufficient time to mobilize their logistics; while hospitals could be prepared to receive more patients (ADPC 2013).

The National Committee for Disaster Management (NCDM) can provide a coordinating role in establishing and implementing early warning programmes through development of an early warning system and capacity building of its staffs. This would allow NCDM to partner with various stakeholders involved in the end to end early warning system from regional to national levels, sectoral ministries, the provincial committees for disaster management (PCDM), district committees for disaster management (DCDM), commune committees for disaster management (CCDM) and humanitarian agencies as well as the Cambodian Red Cross (CRC). At the same time, investments should be made to improve the existing early warning system (EWS) in Cambodia to make it more efficient and an integrated part of mainstream Disaster Risk Management (DRM) by taking into account the activities and policies of Cambodia's line ministries and strengthening its institutional and legal basis. The early warning system (EWS) should have the ability to consider previous problems associated with insufficient warning information and potential future problems associated with social vulnerability, capacity, and disaster event variability in terms of increased frequency, severity, unpredictability, and spread to areas that were previously relatively unaffected.

2. METHODOLOGY

The study involved carrying out a detailed gap assessment from national to the community (commune) levels through interviews, group discussions, consultation meetings, provincial meetings, district and commune level meetings. The main purpose of these meetings was to assess the gaps in existing early warning systems through a questionnaire survey as well as reviewing the existing documentations and systems available with various departments and line ministries. The meetings were conducted with the aim to understand the people's knowledge towards early warning systems and their awareness towards warning dissemination.

2.1 Data Collection

A three stage data collection and review process was involved in conducting the gap assessment:

- Questionnaire surveys
- Reviewing the existing weather related early warning systems
- Reviewing the communication networks and links

This was followed by conducting the gap assessment for each stage of an early warning system.

2.1.1 Questionnaire Survey through Scoring System

The survey mostly includes interviews and focus group discussions related to warning messages disseminated from the national to the commune levels and how best these warnings are used for effective response. For any early warning system to be effectively functioning, flow of information from national to local level is important. The gaps were assessed through a scoring system ranging from 0-5. The scores are based on the people's perceptions and opinions on early warning systems at the national, provincial, district and the commune levels. The brief description of the scoring system is given below (Table 1).

Table 1. Scoring system with the scale definitions

Score	Levels	Scale Definition
0	None	No information on early warning
1	Very Low	Rarely receives the warning messages
2	Low	Flow of early warning information is low (sometimes it is received and sometimes does not reach the intended audience)
3	Medium	Flow of early warning information is medium
4	High	Quick flow of early warning information
5	Very High	Effective warning system

2.1.2 Review of Existing Weather Related Early Warning Systems in Cambodia

Detailed review conducted by the technical experts from Asian Disaster Preparedness Center showed that at the National Level, MOWRAM through its two technical departments: Department of Hydrology and River Works (DHRW) and Department of Meteorology (DOM), is mandated to produce and disseminate flood and weather forecasts and warnings for the entire country. However, at the local level, the Provincial Department of Water Resources and Meteorology (PDOWRAM) does not have the capacity to produce the flood and weather forecasts. They receive the information from MOWRAM (DHRW and DOM) and further disseminate the forecasts and warnings to communities through their networks (phone, radio-communication). NCDM also plays an important role in disseminating flood forecasts to the communities via the PCDM, DCDM and CCDM as well as the Cambodian Red Cross (CRC). At the community level, the village chief is responsible for disseminating the warnings. Mostly dissemination takes place by fax, telephone, walkie-talkie (ICOM), loud speaker and from person to person.

2.1.3 Review of Communication Networks and Links

To strengthen the early warning system (EWS) in Cambodia, the main task involved was to identify, meet and engage with all relevant stakeholders involved in the generation and dissemination of early warning. The key stakeholders include the major regional and national meteorological and hydrological organizations as well as representatives from local administration at provincial, district and commune levels, particularly from hazard-prone areas to provide a local or field level perspective to the process.

2.2 Gap Assessment

With all the information collected through questionnaire surveys, reviews and in consultation with key persons in the community such as frequency and severity of past hazards, vulnerable households and groups, spatial characteristics, existing social groups, indigenous early warning practices and capacity of the community, the information are then analyzed with community representatives and the outcomes from the consultations were used to suggest establishment and strengthening of early warning systems for reducing the vulnerabilities of communities. The communities were considered as the key actors in identifying their situations and the extent of awareness they have on early warning systems to ensure successful outcome of the mapping, analysis and effectiveness of the system. This participatory process was conducted in a way where it was assumed that the people are the experts and are the ones to know the reality of their community.

Based on this understanding, the gap assessment was carried out at the national, provincial, district and community (commune) level. The survey was done considering the four pillars of EWS discussed above and the gaps at each stage of EWS was assessed through interviews and focus group discussions. The

results obtained were then put in a spider diagram to get a better understanding of the gaps observed in the existing systems. Some of the areas covered during the gap assessment includes:

- Risk knowledge: inadequate emphasis on social, economic and environmental vulnerability; inclusiveness and public participation in vulnerability assessment; gaps in data; and the lack of early warning indicators;
- Monitoring and warning services: capacities in monitoring and warning services; coverage and sustainability of observing systems for monitoring of hydro-meteorological hazards; understanding the technical capacities in terms of resources, expertise and operational warning services, in the operational technical agencies responsible for monitoring and forecasting of severe events; availability of data exchange policies and procedures as well as access to information from other countries in the region; availability of multi-agency coordination mechanism and effective communication systems;
- Dissemination and communications: understanding the institutional arrangements; whether there is proper clarity and completeness in the warnings issued; whether updated systems are in place; availability of standard nomenclature, protocols, and standards both nationally and internationally; availability of proper public address system; and awareness about understanding the vulnerability;
- Response capability: understanding the multi-agency collaboration and clarity of roles and responsibilities at national to local levels; understanding the level of public awareness and education on early warning response; whether simulations and drills are conducted; understanding the public concerns; and public awareness on vulnerability.

The assessment scheme contained specific indicators that reveal the gaps and needs of the existing system through reconnaissance, consultations with the stakeholders, meetings with national institutes, civil society organizations and Cambodian Red Cross.

3. RESULTS AND DISCUSSION ON THE ANALYSIS OF GAPS IN EXISTING EARLY WARNING SYSTEMS

The existing early warning system in Cambodia follows a structure which is largely built on the existing governmental services structured around the key departments under the Cambodia's Ministry of Water Resources and Meteorology (MOWRAM). The key departments within MOWRAM are Department of Meteorology (DOM); and Department of Hydrology and River Works (DHRW). While MOWRAM acts as the source agency for observation, detection and warning formulation, the National Committee for Disaster Management (NCDM) remains as the central agency to disseminate the early warning information to the provincial committees for disaster management (PCDM), district committees for disaster management (DCDM), commune committees for disaster management (CCDM), the Cambodian Red Cross (CRC) and subsequently to the other entities of the last mile communication that are coordinated for emergency operations and response towards the early warning. This chain apparently starts from the national level and ends at the community level. However, on many occasions in the past, it was observed that the operational chain remained problematic and in many cases were not performed effectively during disaster situations resulting in variable impacts and damages. The main cause of these was due to the presence of several layers of gaps and weaknesses existing within the current system. Although the early warning (EW) and preparedness capacities exist in Cambodia, they are still insufficient and not systematically designed, leading to ineffective provision and unreliable information to the public, especially to the communities at risk. The gap assessment conducted from national to

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commune levels was based on a scoring system with a scale ranging from 0 to 5 as mentioned in section 4.1.1.

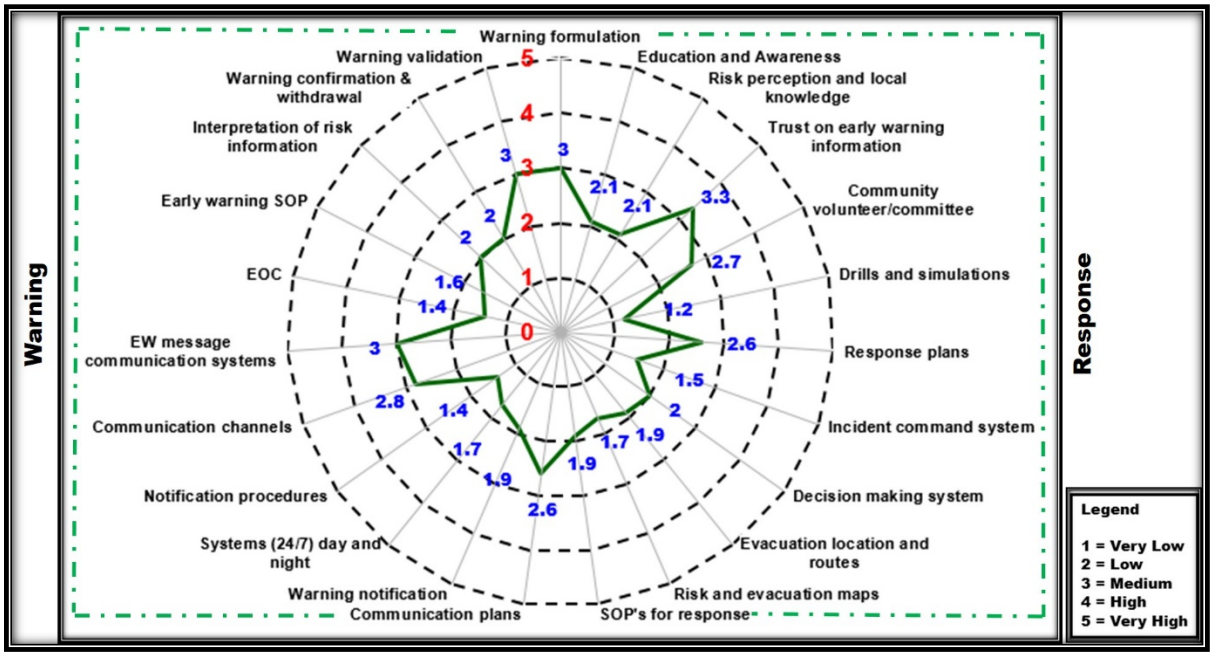

Figure 2. Spider diagram showing the existing gaps at various stages of early warning system in Cambodia (Legend: 1 = Very Low; 2 = Low; 3 = Medium; 4 = High; and 5 = Very High)

Detailed assessment conducted at the national level as well as in eight different provinces showed that there exist numerous gaps in the existing setups for effective warning dissemination in the country (Figure 2). It also showed that the present system is more focused towards hydro-meteorological hazards rather than multi-hazard. The system in its present form lacks a multi-hazard approach (Multi-Hazard Early Warning System (MHEWS)) and the national, provincial and commune level consultations suggest that there are gaps in the existing system in terms of systematic warning and response. Based on the interviews and focus group discussions, the average rankings were put in a spider diagram where the views expressed by the participants gave a diagrammatic representation of the status of early warning systems in Cambodia by representing data proportionately to the scale based on the scores assigned to it.

In terms of *warning capability*, the assessment shows that at the national level, warning formulation and validation does take place, however, interpretation of information and use of early warning SOP's are found to be lacking. Cambodia do have a good communication system but notification procedures during any emergency situation seems to be lacking. Also there is the absence of systems in place as required for 24 x 7 operation which could also be seen as a major gap.

In terms of *response capability*, the assessment results showed that the existing systems do not have the required steps from SOP's to Incident Command System (ICS). However, they do have response plans, volunteers as well as the trust, on the early warning information received from the authorities. Other areas where gaps could be observed are in case of simulations and drills which are lacking in the present system as well as lack of awareness in terms of risk perception and local knowledge. Gaps in the existing early warning system starting from warning generation to disseminating to the communities at risk are foreseen and identified as a lack of human resources, reliable information, equipment and budget through this study.

In terms of *weather and flood monitoring*, warning issuing and dissemination both at national and local levels, the gaps mostly includes aging and insufficient observation networks and data communication facilities, ineffective data sharing or dissemination among agencies, lack of skilled human resources in using the modern computing tools (numerical weather prediction, flood forecasting models and so on) to produce reliable information and interpreting newly generated forecast products. The unpredictability and increasing severity of extreme weather events clearly requires significant improvement in capacity for early warning and preparedness. For the purposes of improving management of extreme weather events in the context of a changing climate, early warning system should consider both previous problems associated with insufficient warning information and potential future problems associated with social vulnerability, capacity, and disaster event variability in terms of increased frequency, severity, unpredictability and their spread to areas that were previously relatively unaffected.

In terms of dissemination of the early warning to the public and particularly to the communities at risk, the main gaps observed are lack of Standard Operating Procedures (SOP), lack of capacity to make use of generated forecasts to explain to the public, lack of adequate funding and means of transportation and communication. Nevertheless, public awareness and response are also a big concern. Investments should be made to improve the existing early warning system in Cambodia to make it more efficient and an integrated part of mainstream Disaster Risk Management (DRM) by taking into account the activities and policies of Cambodia's line ministries and strengthening its institutional and legal basis.

4. CONCLUSIONS

Considering the present gaps in the existing system, it is felt that for effective warning and response dissemination, it is essential that the early warning system is tailored to the requirements of the end-users, and fits within the existing and expected institutional resources. For this to happen, a programme needs to be implemented which will improve the quality, efficiency and utility of existing systems in the country through a multi-hazard approach. An automated multi-hazard early warning system is also recommended with structured early warning focused sections and other types of interaction with decision-makers such as on-demand briefings and unstructured interaction. This program once established will also require the need to consider and integrate early warning information concerning emerging natural and humanitarian disasters. The study further suggests that strong communication linkages are very essential from national to commune levels as well as greater coordination between National Committee for Disaster Management (NCDM) and Ministry of Water Resources and Meteorology (MOWRAM) which could then effectively handle the smooth dissemination of information.

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