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Abbreviations and Acronyms

ADPC	Asian Disaster Preparedness Center
ARIMA	Auto Regression Integrated Moving Average
ASEAN	Association of South East Asian Nations
BMG	Bureau of Meteorology and Geophysics, Indonesia
CDPP	Calamities and Disaster Preparedness Plan, Philippines
DDMFC	Department of Dyke Management and Flood Control, Vietnam
DHRW	Department of Hydrology and River Works, Cambodia
DMC	Disaster Management Committee
DMH	Department of Meteorology and Hydrology, Lao PDR
DoM	Department of Meteorology, Cambodia
ECHO	European Commission Humanitarian Aid Office
ENSO	El Niño Southern Oscillation
EWS	Early Warning System
FF	Flood Forecasting
FFB	Flood Forecasting Branch
FFWSDO	Flood Forecasting and Warning System for Dam Operation
GDPS	Global Data Processing System
GMS	Geo-stationary Meteorological Satellite
GOS	Global Observing System
GTS	WMO Global Tele-Communications System
HMS	Hydrometeorological Services, Vietnam
IFRC	International Federation of Red Cross and Red Crescent Societies
IDNDR	International Decade for Natural Disaster Reduction
IHP	International Hydrological Programme
MoWRAM	Ministry of Water Resources and Meteorology
MRCS	Mekong River Commission Secretariat
NCDM	National Committee for Disaster Management, Cambodia
NCHMF	National Center for Hydrometeorological Forecasting, Vietnam
NDCC	National Disaster Coordinating Council, Philippines
NDMC	National Disaster Management Committee, Lao PDR
NDMO	National Disaster Management Office, Lao PDR
NDMOs	National Disaster Management Offices
NMS	National Meteorological Services
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PDCC	Provincial Disaster Coordinating Council, Philippines
PDMFCSP	Provincial Dyke Management, Flood Control and Storm Preparedness, Vietnam
POSKO	Coordination center
RAPI	Amateur Radio Communication Service
RDCC	Regional Disaster Coordinating Council, Philippines
RSMC	Regional Specialized Meteorological Center
SFA	Seasonal Forecast Areas
SOI	Southern Oscillation Index
SST	Sea Surface Temperature
WAD	Waterways Administration Division, Lao PDR
WDR	World Disaster Report
WMO	World Meteorological Organization
WQA	Water Quality Analysis
WWW	World Weather Watch

Preface

Early warning empowers individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner so as to reduce the possibility of injury, loss of life and damage to property and environment (International Decade for Natural Disaster Reduction, 1997). Vulnerable populations, local communities, national governments, regional institutions and international bodies have responsibilities to contribute to this empowerment. As a regional institution, ADPC supports the sharing of early warning information especially among countries that share a common geographical environment.

In 1995, the United Nations General Assembly requested the IDNDR Secretariat to review early warning capacities and recommend means by which global practices could become better coordinated and made more effective. In 1998 the International IDNDR Conference on Early Warning Systems for the Reduction of Natural Disasters was held in Potsdam, Germany, which underlined the importance of early warning in effective disaster preparedness and mitigation, and provided guidelines for effective early warning at local, national, regional and international levels.

In this light, the 3rd ASEAN Regional Forum Inter-Sessional Meeting on Disaster Relief (ARF ISMDR) in April 1999 in Moscow recognized the need to take stock of current national capacities in early warning systems, identify gaps in expertise and resources, and recommend steps to enhance early warning capacities. It was planned to use this inventory in the preparation for an ARF Conference on Enhancing Capacities of Early Warning Systems, which Philippines proposed to conduct. The 4th ARF ISMDR in May 2000 in Hanoi recognized the urgency in the stock-taking of early warning capabilities, as they considered cooperation in early warning as a critical component of disaster preparedness and mitigation in the region.

Cognizant of this need and in accordance with the International Decade for Natural Disaster Reduction (IDNDR) objectives, the Asian Disaster Preparedness Center (ADPC), with funding support from the Disaster Preparedness program of the European Commission Humanitarian Aid Office (DIPECHO), conducted in 2001 a review of international initiatives on early warning and a rapid appraisal of existing early warning systems for hydrometeorological hazards in the DIPECHO target countries of Cambodia, Indonesia, Lao PDR, Philippines and Vietnam. Short case studies were also undertaken to assess community response to the hazard warning.

The study revealed that most of the selected countries have been able to establish well-developed systems of data collection and sharing for short-range weather forecasting, with the support of the World Meteorological Organization and other regional and international organizations. There is, however, a need to enhance the technical infrastructure and capacity to produce, interpret and communicate seasonal and long-range forecasts in Cambodia, Lao PDR, and Vietnam. Capacities in flood forecasting in the Lower Mekong River Basin have improved with assistance from the Mekong River Commission. Cambodia, Lao PDR and Vietnam have been successful in documenting upstream real time hydrometeorological data. However, there is still a need to increase the number of observation stations to extend coverage of forecast.

Dissemination systems exist in the countries, but require support to improve communication of the warning message to the public to enable timely and appropriate

response. This would involve preparation of the warning message that will be well understood by the public, resources for communication hardware, and public awareness and education on warning. Risk assessment plays a vital role in identifying what communities in which areas are most vulnerable, a critical input in effective response to the warning.

Organizing the community to respond appropriately to the warning is a challenge. Public awareness on the impending impact of a hazard, and understanding the warning content and recommended action are required for the public to believe the warning and take the appropriate action.

The International Strategy for Disaster Reduction (ISDR), the successor to the IDNDR, continues to maintain international momentum in the development of early warning capacities. The ISDR Working Group on Early Warning led by the United Nations Environment Programme (UNEP) is developing a global inventory of early warning systems as part of an ISDR initiative to develop a program on early warning. The holding of a second conference on early warning systems is being planned in 2003. This document is a contribution towards this initiative.

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Executive Summary

Globally, the incidence of hydrometeorological disasters has doubled since 1996. In the past decade more than 90% of the people killed by natural hazards lost their lives due to droughts, windstorms and floods, of which 85% of the total deaths were reported from Asia (WDR, 2001). Strengthening disaster reduction strategies throughout the region is an important step towards ensuring that natural hazards do not result in social and economic disasters.

The UN International Decade on Natural Disaster Reduction (IDNDR) Conference on Early Warning Systems for Reduction of Natural Disasters (held in Potsdam, Germany in September 1998) declared that the successful application of early warning is the most practical and effective measure for disaster prevention. Ultimately, the declaration continues, early warning systems must be comprehended by and motivate communities at greatest risk, including those disenfranchised and particularly disadvantaged people who must take appropriate protective actions.

One of IDNDR's original program targets was for all countries to have in place, by the year 2000, ready access to global, regional, national and local warning systems as part of their national plans. Many governments and related disaster management organizations throughout Asia have already initiated Early Warning Systems; though, the resulting systems vary widely in their capacity to produce and communicate effective warnings.

This report summarizes the findings of a study of Early Warning Systems in Cambodia, Indonesia, Lao PDR, Philippines and Vietnam, the countries targeted by the Disaster Preparedness Program of the European Commission Humanitarian Aid Office (DIPECHO). The study, conducted in accordance with the IDNDR objectives, was undertaken by Asian Disaster Preparedness Center's Partnerships for Disaster Reduction-South East Asia (PDR-SEA) project, which emphasizes the need to address disaster related issues within the context of sustainable development, with communities targeted as major beneficiaries[1]. Most broadly, the project aims to develop the capacities of communities to prevent or mitigate the impact of disasters.

This report attempts to raise awareness of the early warning systems in the respective countries and to provide a basis for further enhancing institutional mechanisms, technical capacities and community response options for reducing vulnerability to extreme climate events. The study has the following objectives:

- Review the international initiatives on early warning system
- Conduct a rapid appraisal of existing early warning system for hydrometeorological hazards in DIPECHO target countries, and
- Undertake short case studies to assess community-level vulnerability and response to hydrometeorological hazards.

Huge populations in the selected countries are highly vulnerable to hydrometeorological hazards as large numbers of communities are settled in risk prone marginal areas. Fertile flood valleys, plains and deltas, such as the Lower Mekong River basin, are attractive to farmers as they provide access to livelihoods; but they are also most vulnerable to floods.

[1] This project was funded by the Disaster Preparedness Program of the European Commission Humanitarian Aid Office (DIPECHO) in February 2001 as part of the Second DIPECHO Action Plan for Southeast Asia.

In urban areas, burgeoning populations are in many instances located in areas vulnerable to hazards such as tropical storms. This study is limited to the EWS for hydrometeorological hazards focusing on tropical cyclone and floods as recommended in the proposal approved by the European Commission Humanitarian Aid Office (ECHO).

Early Warning

Early warning provides communities with timely information, enabling them to prepare for an anticipated hazardous event such that the impacts of the event on lives, livelihood and property are minimized. The early warning process is dependent on the interplay of science, technology and socio-economic factors that dictate the manner in which people understand and react to disasters.

Five general components to effective early warning systems may be distinguished conceptually, though in practice these elements are closely inter-related. Nevertheless, these components provide a useful logical framework against which to assess early warning capacities.

- Risk Assessment, including hazard assessment and vulnerability analysis
- Hazard detection and prediction
- Formulation of warning messages
- Dissemination of warning messages
- Community response

Early Warning Capacity of Selected Countries

Most of the selected countries have been able to establish well-developed systems of data collection and sharing for short-range weather forecasting, with the support from the World Meteorological Organization and other regional and international organizations. With respect to seasonal and long-range forecasts, there is a need to enhance the technical infrastructure and capacity to produce, interpret and communicate seasonal and long-range forecasts in Cambodia, Lao PDR and Vietnam. Even though El Niño and La Niña events have a significant impact on local weather and climate related hazards, as evidenced by the catastrophic floods that affected central Vietnam in 1999, there has not been enough effort to prioritise seasonal forecasts. The absence of an intermediate mechanism that interprets an ENSO forecast and converts it into locally usable information has also proved to be a formidable barrier to the decision making process.

As floods cause maximum loss to life and property in Laos, Cambodia and Vietnam, flood forecasting is their prime concern. Lately, there has been substantial investment from donors to improve the hydrometeorological network of these countries. Assisted by the forecast from the MRCS stations, these countries have been successful in documenting real time hydrometeorological data from the upstream. However, the real time data is received from few stations and accordingly the forecasts are limited to a handful of sites.

Communities show a high level of resilience and act from experience or on instinct to survive. In the study conducted, there were cases where communities hesitated to evacuate to safer places due to their reluctance to leave their personal properties. The case study from Indonesia is a good model of how the community can be a part of an early warning system.

Recommendations

Mitigation should be viewed as one part of an integrated disaster management system that includes sustained attention to risk management and mapping of vulnerable communities.

There is an urgent need to promote community-based early warning systems based on maps of the vulnerable areas of villages, districts and provinces.

Effective disaster management also requires coordination and cooperation between responsible agencies, institutions, officials, the media, political leaders and other players at local, national and international levels.

Move towards a proactive approach and development of effective national and regional frameworks to facilitate prompt action. This can be realized through improved communications, mobilizing government support, raising awareness (impacts, safety measures, mitigation options and EWS) and building on existing knowledge and institutional structures and programs.

Sustained political will is the most essential ingredient to establishing effective early warning capacity. Substantial progress may be achieved by capitalizing on momentum generated by international, regional and national level projects.

With respect to seasonal and long-range forecasts, there is a need to enhance the technical infrastructure and capacity to produce, interpret and communicate seasonal and long-range forecasts. This need is most urgent in Cambodia, Lao PDR and Vietnam but the Philippines and Indonesia can benefit greatly from additional technical support as well.

One way to strengthen existing Early Warning Systems is through ensuring the availability of trustworthy El Niño forecasts. Better forecasts will require application of new advances in modeling (statistical and dynamical) that enhance skill in downscaling, improve lead time, establish a community of trained technical personnel capable of forecasting, understanding the impacts of disasters and communicating this critical information to decision makers.

In most countries the dissemination systems exist but are not maintained, in part because the sporadic incidence of hazards can lull decision makers into a false sense of security. Though in most countries the dissemination structure extends to the local level, the communication infrastructure is not effectively used. The reasons for the breakdown in communications need to be examined more closely and specific gaps need to be identified and bridged.

As warning for hydrometeorological hazards is limited to the capacity of the existing infrastructure to forecast potential disasters, the mutual exchange and cooperation between the five countries would serve as an important tool for efficient early warning.

Finally, effective communication channels between local meteorology and climatological agencies, other relevant agencies and stakeholders in potentially affected sectors need to be set up with some urgency in order to facilitate appropriate means of dissemination of warnings and other information.

Table 1: Hazard forecast institutions and responsibilities

Country	Forecast	Institutions and Infrastructure	Activities
Cambodia	Weather and tropical storms	Department of Meteorology (DoM), Ministry of Water Resources and Meteorology (MoWRAM) MoWRAM	- Data collected from 14 synoptic stations and RSMC - Issue of 24 hour forecast - Warning disseminated to Minister offices, NCDM, Media, fishermen, farmers - Monitor ENSO impact on the country - Monthly average and minimum temperature
	Floods	Department of Hydrology and River Works (DHRW), MoWRAM - 1 office for flood forecasting - 15 provincial hydrometeorological offices - 6 observation stations with 3 data loggers - 72 newly established rain stations	- Applies local models and Regression Analyses and Sogreah Model Analyses for prediction - 3 days of water level prediction and warning - Communication by radio, messenger - Data sent to MRCS by facsimile - Receive water level data of 4 countries sent by MRCS
Indonesia	Weather	Bureau of Meteorology and Geophysics (BMG) - Application of Stochastic Models and ARIMA for weather prediction - Assisted by the application of RAINMAN software from Australia	- 2 seasonal forecast and monthly forecast in the SFA, dry season forecast (before March) and wet season forecast (before Sept.) - Takes into account ENSO parameters for seasonal forecast
Lao PDR	Weather and flood	Department of Meteorology and Hydrology (DMH) - 74 hydro stations - 86 rainfall stations - 34 meteorological stations Water Administration Division (WAD) - 64 hydro stations - 23 rainfall stations	- Hydrometeorological data collection - Daily and long range forecast - Provide hydrometeorological services to Ministry of Agriculture, Forestry and Environment - Data transferred from local stations by messenger, post, television, internet - Hydro meteorology data collection - Data from WAD forwarded to MRCS by email and fed in computers
	Typhoon	- World Area Forecast Center, Bracknell, Regional Specialized Meteorological Center (RSMC)	- Supplies tornadoes warning - Low resolution meteorological satellite receives satellite photos from GMS-5 - Warning disseminated through the Bangkok node
Philippines	Weather, typhoon	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) - 60 synoptic stations that send daily weather data to central forecast office - Global spectrum model used to analyze and results translated into weather forecasts	- 3 hourly weather observation - Weather map as a tool for distribution of atmospheric pressure, wind temperature and humidity - Hourly satellite images from GMS-5 and cloud coverage - Data sent from synoptic stations via single band radio, telephone, email - 6 hourly weather observation sent to other countries, RSMC and Global Telecommunication System (GTS)
	Flood	Flood Forecasting Bureau (FFB)	- Monitoring and data collection from rain gauges and sent to Central Flood Forecasting Office. - Flood forecasting models used for analyses of flood situation
Vietnam	Weather, flood	Hydrometeorological Services (HMS)	- Prepares weather and flood forecast - Operates a high resolution satellite image receiving system and five radar system - 2 regional hydrometeorological centers - Plans for flood hazard zones in under a UNDP/USAID project and a flood alert system on river basin m0st vulnerable to floods.

Table 2: Hazard warning and dissemination

Country	Hazard/ Responsibility	Warning	Dissemination
Cambodia	Floods National Center for Disaster Management (NCDM)	- Two level of flood warning: flood advisory and flood warning	- NCDM transmits information on flood situation, through a sub-national committee on disaster management - Up till the village level - Tools commonly used are fax, messenger, and telephones. - Hand held radio used by district offices but not maintained
Indonesia	Floods Disaster Coordination Center (POSKO)	- POSKO issues the warning with information on: type of flood, time and place of occurrence, effect of the flood, steps to be taken, and maps of flood prone areas - BMG is responsible for seasonal forecast	- POSKO relies on media to disseminate information (extensive briefing on radio, TV and newspapers) on existing conditions and river heights - Informal and community networks also serves as an important medium for warning dissemination - Provides a published document on total rainfall intensity for wet and dry season; and also seasonal forecast for the Seasonal Forecast Areas (SFA)
Lao PDR	Weather, Tropical Storms NDMO	- For rainy season forecast issued twice a day - During inclement weather forecast is issued 3 times a day - Typhoon warning contains the typhoon characteristics, risk on people, recommended action to prevent and mitigate	- Warning sent to a number of media (for further dissemination), all levels of government, ministries and private companies - Mobile phones and high frequency radio receivers
Philippines	Tropical Cyclone PAGASA	- 3 categories of tropical cyclone warning: Weather advisory, Tropical cyclone alert, and Tropical cyclone warning - 3 categories of flood bulletin: flood outlook, flood advisory and flood warning	- Multi-pronged dissemination scheme - Public receives information directly by PAGASA or TV broadcast, regional warning centers and dam offices
Vietnam	Flood Provincial Dyke Management, Flood Control and Strom Preparedness (PDMFCSP)	NA	- Village radio communications - Loud speakers in communities

1. Introduction

1.1 Background

The Asian region is the most disaster prone region in the world. It experiences almost every conceivable hazard - geological hazards such as earthquakes, landslides and volcanoes; hydrometeorological hazards such as floods, cyclones and droughts; and other hazards such as epidemics, insect infestations, hot and cold waves, and forest fires. Amongst the hazards, hydrometeorological hazards are the most common and they pose considerable threat to life, property and environment.

Globally, the incidence of hydrometeorological disasters has doubled since 1996. In the past decade more than 90% of the people killed by natural hazards lost their lives due to droughts, windstorms and floods of which 85% of the total deaths were reported from Asia (WDR, 2001). Strengthening disaster reduction strategies throughout the region is an important step towards ensuring that natural hazards do not result in social and economic disasters.

The UN International Decade on Natural Disaster Reduction (IDNDR) Conference on Early Warning Systems for Reduction of Natural Disasters (held in Potsdam, Germany in September 1998) declared that the successful application of early warning is the most practical and effective measure for disaster prevention. Ultimately, the declaration continues, early warning systems must be comprehended by and motivate communities at greatest risk, including those disenfranchised and particularly disadvantaged people who must take appropriate protective actions.

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The study was undertaken by Asian Disaster Preparedness Center's Partnership for Disaster Reduction-South East Asia (PDR-SEA) Project, which emphasizes the need to address disaster related issues within the context of sustainable development, with communities targeted as major beneficiaries[2]. Most broadly, the project aims to develop the capacities of communities to prevent or mitigate the impact of disasters. This report attempts to raise the awareness of early warning systems in the respective countries and to provide a basis for further enhancing institutional mechanisms, technical capacities and community response options for reducing vulnerability to extreme climate events.

1.2 Hydrometeorological Hazards and Extreme Climate Events

The most frequent hydrometeorological hazards experienced in South East Asia are windstorms, floods and droughts. Table 1.1 illustrates the relative intensity of hazards experienced in selected countries. Floods pose the maximum risk and the problem is most

[2] The Disaster Preparedness Program of the European Commission Humanitarian Aid Office (DIPECHO) funded this project in February 2001 as part of the Second DIPECHO Action Plan for Southeast Asia.

acute in the large Mekong river delta where people depend on the productivity of flood plains for their subsistence and livelihoods.

Table 1.1: Relative intensity of hazards faced by selected countries

Country	Typhoons	Floods	Drought
Cambodia	L	S	M
Indonesia	L	M	M
Lao	L	M	L
Philippines	S	S	L
Vietnam	M	S	L

Legend S- Severe; M-Moderate; L-Low
Source: Adapted from Whitehouse & Burton, 1999 for water related hazards

Windstorms

In the past decade about 17% of the disasters in the Asia-Pacific Region were triggered by windstorms (WDR, 2000). Vietnam and Philippines are highly exposed to typhoons and cyclones. An average nineteen typhoons strike Philippines every year while Vietnam experiences six typhoons annually. Typhoon related disasters include floods, strong winds, storm surges, landslides and mudslides. Typhoon related floods caused an estimated US$ 266 million in losses in Vietnam. The same year, in the Philippines, the relative damage caused by the various typhoon related hazards was reported[3] as follows:

Floods:	US$ 1,829 million
Strong Winds:	US$ 1,691 billion
Landslides:	US$ 1,290 million

Floods

Floods account for forty percent of the natural hazards affecting Asia and the Pacific. In Asia alone in the last decade more than 83% of the total reported disasters were due to floods (WDR, 2000). Flooding is main natural hazard in Philippines, Cambodia, Vietnam and Lao PDR. In the year 2000, flooding was particularly severe for Southeast Asia as a long episode of monsoon rains and storms brought widespread overflow in the countries along the Mekong River Basin, namely Lao PDR, Cambodia and Vietnam. The floods lasted from July to November, raising the Mekong River above the danger level of 10.50 meters. In Cambodia alone, the National Committee for Disaster Management reported that 347 people lost their lives and 750,618 families (3,448,629 individuals) were affected. In the Philippines, floods are responsible for the second highest death toll due to a natural hazard.

Although hydrometeorological and extreme climate factors result in flooding, its devastating impact is exacerbated due to inefficient planning and management of land use, lax regulations towards natural resource use, uncontrolled deforestation, soil erosion, increased urban pressure and political biases. The 10 August 2001 flood that caught the Northeastern Thais off-guard was clearly a result of environmental degradation where the flooding impact was aggravated by lack of preparedness. Large numbers of people that settle along the rivers and canals in order to better access the center of the city become more vulnerable to flooding. In the cities and towns, urbanization has resulted in increased unplanned use of marginal land (flood plains) where the risk of flood is high.

[3] *Report of the Regional Survey on Strengthening Cooperation in the Hydrological and Disaster Prevention and Preparedness Components of the Typhoon Committee.* Prepared for the Typhoon Committee Working Group on Hydrological Component. 15 October 2001

Droughts
Asia is very vulnerable to droughts. In the last ten years 31 droughts have been recorded; many of which are associated with climate anomalies of unusual geographic extent or duration. The onset of drought is slow and the effects are long lasting. India, Pakistan, Afghanistan, Philippines, Indonesia, the South Pacific, Australia, Northern China, Korea and Bangladesh are among the most affected regions[4]. Recent droughts in South East Asia are clearly linked with the El Niño Southern Oscillation.

El Niño Southern Oscillation (ENSO)
The El Niño Southern Oscillation (El Niño and La Niña events) significantly affects society and the environment in Southeast Asian countries. Although there are significant local variations, rainfall in most parts of the region tends to be below average during an El Niño year, leading to droughts, while the occurrence of tropical cyclones and associated flood incidences tends to be below average. Indonesia and Malaysia experienced droughts due to this phenomenon. The most dramatic and disastrous effects of 1982-83 and 1997-98 El Niño events in Indonesia were manifested in the large-scale forest fires that destroyed an excess of 9 million hectares of forest and land.

On the other hand, during a La Niña year, the rainfall tends to be above average with increased frequency of tropical cyclones, resulting in higher frequency and severity of floods. On the other hand, in some locales, a La Niña year also provides opportunities for advancing the planting season, leading to an early increased harvest as well as possibilities for harvesting one additional crop.

1.3 Vulnerability

Natural hazards – such as floods or earthquakes – are inherently neutral. Natural disasters occur when a hazard impacts people, property, valued environments and critical infrastructure. A cyclone in a remote part of the ocean, for instance, is not a disaster but merely a meteorological event. Disasters are inextricably linked to the vulnerabilities of people, place and infrastructures. Vulnerability may be viewed as a function of exposure, sensitivity and resilience. Some sectors, for instance agriculture or transportation, are especially sensitive when exposed to extreme climate events. For other sectors or populations, sensitivity may be offset by resilience – the ability to resist or recover from the damage associated with the convergence of multiple stresses.

The International Federation of Red Cross, Viet Nam, for example, assessed the flood victims in the Mekong Delta and found that the wealthier inhabitants were more adaptive and resilience. They were better able to withstand floods because they could afford to raise the foundations of their houses above the usual flood level and, because they did not depend on a daily wage for their economic survival, their livelihoods were not so badly affected. The landless poor, on the other hand, had little room to manoeuvre; floods cut them off from food, fuel and income by stopping them from collecting wild vegetables, cutting firewood and working as day labourers (Twigg, 1999[5]).

Ninety per cent of disaster victims worldwide live in developing countries, where poverty and population pressures force growing numbers of poor people to live on marginal risk

[4] ADPC, 2001; Overview of Disasters in Asia Pacific
[5] http://www.bghrc.com/DMU/DEVRISK1/DEVRISK/TWIGG.HTM

prone land – on flood plains, in earthquake-prone zones and on unstable hillsides. A study by CRED, 2001 concluded that in the past decade, on an average, every disaster in low human development[6] countries claimed about 1062 lives and each disaster in middle human development countries claimed 145 lives. These figures stand in stark contrast to the average of 22.5 people killed per disaster in high human development countries (WDR, 2001).

Huge populations in the countries studied in this project are highly vulnerable to hydrometeorological hazards as many communities are settled in risk prone marginal areas. Fertile flood valleys, plains and deltas, such as the Lower Mekong River basin, are attractive to farmers as they provide access to livelihoods, but they are also most vulnerable to floods. In urban areas, burgeoning populations are in many instances located in areas vulnerable to hazards such as tropical storms.

1.4 Disaster Management and Early Warning Systems

Disaster management seeks to reduce the impact of hazards through mitigation, preparedness, response and recovery. The application of climatological and hydrological knowledge to the assessment of risk, to land-use planning and to the design of structures contributes to disaster mitigation. Classical forecasts and warnings of impending severe weather, extreme temperatures, droughts or floods, contribute to preparedness. Timely and effective warnings of natural hazards coupled with local capability to take avoidance or mitigating actions are fundamental for disaster reduction. Updated warnings, forecasts, observations and consultation with emergency and relief agencies contribute to the response phase.

Hydrometeorological hazards are particularly appropriate targets for early warning enhancement efforts. The trans-boundary and regional character of the hazards provides substantial rationale for the appraisal of the existing early warning system in the selected countries. The review of the early warning system will further awareness of the early warning capacities of the respective countries and provide a platform for capitalizing on the countries' strengths and create mechanism for exchange.

1.5 Objectives

This study was conducted in accordance with the IDNDR objectives and builds on the needs and priorities identified at the 3rd and 4th ASEAN Regional Forum Inter-Sessional Meeting on Disaster Relief (ARF-ISMDR) to develop a review of current national capacities in early warning systems, identify gaps of expertise and resources, and recommend steps for improvement. The study has the following objectives:

- Review the international initiatives on early warning system
- Conduct a rapid appraisal of existing early warning system for hydrometeorological hazards in DIPECHO target countries, and
- Undertake short case studies to assess community vulnerability and response to hydrometeorological hazards.

[6] UNDP developed a human development index that is a composite of income, literacy and health level.

1.6 Methodology

Rapid appraisals of the early warning system were undertaken in the selected countries. The methodology was based on primary interviews, data collection and secondary references.

The "Guiding Principles for Effective Early Warning" adopted by the 1998 IDNDR Early Warning Conference in Potsdam (Annex 1) were used as an important reference guide during the process of the appraisal. The key issues that were considered included:

- Existing sources of observational data and the process of data communication to the flood forecast office
- Existing processes and systems for disseminating cyclone and flood warnings
- Effectiveness of the flood and cyclone warnings as perceived by the community
- Understanding of the types of warning by the community
- Community knowledge of the steps to be taken when warning is disseminated
- Role of various actors, political leaders, disaster managers and media in early warning dissemination
- Level of contribution from international organizations in enhancing the preparedness of early warning
- Current strategies and plans in place to enhance the EWS
- Community preparedness and mitigation plans in progress.

The capacity of each country was measured following the four stages of early warning:

- Hazard detection
- Hazard warning
- Warning dissemination
- Community awareness

The secondary information was based on document reviews, informant interviews conducted from mid-August to mid-September 2001, when all five countries we

1.7 Limitations and Constraints

This study is limited to the EWS for hydrometeorological hazards focusing on tropical cyclone and floods as recommended in the proposal approved by the European Commission Humanitarian Aid Office (ECHO), the PDR-SEA funding institution.

Fifteen days had been allocated for the field visits and data collection in the five countries included in the research. Due to the time limitation, only one community per country was studied. In the Indonesian country study, because bureaucratic requirements made the community studies difficult, the community-level information in this report was provided by Oxfam GB Indonesia and is based on their work on improving capacity for community level warning systems.

Finally, although risk assessments are mentioned in subsequent sections of this report as a key element of early warning systems, an assessment of assessment capacity is beyond the scope of the current study.