LFEWS

Local Flood Early Warning System

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COOPERATION Republic of the Philippines Federal Republic of Germany

EUROPEAN COMMISSION-DIPECHO Humanitarian Aid

Imprint

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Published by

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Registered offices

Bonn and Eschborn, Germany
T +49 228 44 60-0 (Bonn)
T +49 61 96 79-0 (Eschborn)

Responsible

Dr. Walter Salzer
Environment and Rural Development Program
Program Director and Principal Advisor

2/F PDCP Building, Rufino cor. Leviste Streets, Salcedo Village, Makati, Philippines

T +63 2 892 9051
I: www.enrdph.org
E: walter.salzer@giz.de

Editors

Shaleh Antonio, Yolando De Guzman, Erlinda Dolatre, Ursula Flossman-Kraus, Allen Mollen, Marifel T. Moyano, Olaf Neussner

Layout / Design

Marifel T. Moyano

Contributors

Thomas Fischer, Jacqueline Hernandez, Dave Martinez, Ed Quitariano

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Printed and distributed by

Environment and Rural Development Program
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Place and date of publication

Manila, Philippines
October 2012

Contents

Acronyms & abbreviations

4PPADP	Four-Point Plan of Action on Disaster Preparedness
AIP	Annual Investment Plan
BDC	Barangay Development Council
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (German Federal Ministry for Economic Cooperation and Development)
CBA	Cost Benefit Analysis
CBMS	Community-based Monitoring System
CCA	Climate Change Adaptation
CDP	Comprehensive Development Plan
CDRRMO	City Disaster Risk Reduction and Management Office
CLUP	Comprehensive Land Use Plan
CSC	Civil Service Commission
CSS	Client Satisfaction Survey
DBM	Department of Budget and Management
DENR	Department of Environment and Natural Resources
DILG	Department of Interior and Local Government
DIPECHO	Disaster Preparedness ECHO
DOST	Department of Science and Technology
DPP	Disaster Preparedness Plan
DPWH	Department of Public Works and Highways
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DRRM	Disaster Risk Reduction Management
DRRMO	Disaster Risk Reduction and Management Office
DSWD	Department of Social Welfare and Development
ECHO	European Community Humanitarian Aid Office
EnRD	Environment and Rural Development Program
EO	Executive Order
FEWS	Flood Early Warning System
FGD	Focused Group Discussion
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation)
HFA	Hyogo Framework of Action
IEC	Information and Education Campaign
IRR	Implementing Rules and Regulations
LCE	Local Chief Executive
LFEWS	Local Flood Early Warning System
LGU	Local Government Unit
LVO	Local Volunteer Observer
M&E	Monitoring and Evaluation
MDRRMO	Municipal Disaster Risk Reduction and Management Office
MDRT	Municipal Disaster Response Team
MGB	Mines and Geosciences Bureau
MLGU	Municipal Local Government Unit
MOA	Memorandum of Agreement
MPDO	Municipal Planning and Development Office
NIA	National Irrigation Administration
NDCC	National Disaster Coordinating Council
NDRRMC	National Disaster Risk Reduction and Management Council
NDRRMF	National Disaster Risk Reduction and Management Framework
NGO	Non-Government Organization
OCD	Office of Civil Defense
OPCEN	Operations Center
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PD	Presidential Decree
PDRA	Participatory Disaster Risk Assessment
PDRRMC	Provincial Disaster Risk Reduction and Management Council
PDRRMO	Provincial Disaster Risk Reduction and Management Office
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PLGU	Provincial Local Government Unit
PPP	Public-Private Partnership
RA	Republic Act
READY	Hazards Mapping and Assessment for Effective Community-based Disaster Risk Management Project
SMS	Short Message Service
SNAP	Strategic National Action Plan
TOR	Terms of Reference
UNDP	United Nations Development Programme

Summary

The Philippines is no stranger to being ravaged by extreme natural events such as typhoons. Year after year, valuable agricultural lands, settlements and human lives have been claimed by and put at risk by the resultant floods, landslides and mudslides. The most vulnerable are the poor. They often do not know what to do in preparation for disasters or in actual emergencies to save their lives and properties.

For local government units, they still do not have sufficient capacities to deal with natural hazards. They lack expertise, robust local data, management capacity and the funds to plan and implement well-targeted disaster risk reduction measures.

On the policy level, addressing how to manage natural hazards has shifted from reactive disaster management to a proactive disaster risk reduction and management, as underlined by the *Disaster Risk Reduction and Management Act of 2010*. The Strategic National Action Plan (SNAP) 2009-2019, adopted in 2010, further highlighted a change in disaster response that is wider in scope; linking disaster risk reduction to poverty alleviation and sustainable development as well as the importance of people's participation in mainstreaming. The *Philippine Disaster Risk Reduction and Management Act of 2010* was followed by the National Disaster Risk Reduction Framework and the National Disaster Risk Reduction Plan in 2011.

Since 2007, GIZ and partner local governments in Region 8 have accumulated vast experience and knowledge in the setting up and management of Local Flood Early Warning System (LFEWS). LFEWS has a straightforward proposition: human vulnerability and suffering could be reduced by monitoring sources of floods, predicting where and when floods could possibly happen, identifying who would be affected and strengthening the capacity of local disaster risk reduction and management institutions to make informed decisions.

LFEWS is located within the GIZ intervention in Disaster Risk Management that contributes to the strategic framework of the Environment and Rural Development Program of improving the institutional performance of government agencies in sustainably managing natural resources. LFEWS traces its origins from GIZ (then GTZ) cooperation with various government agencies and programs in the field of DRM since early 2005.

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

The political, economic, social and ecological criteria for the sustainability of LFEWS are present. The current legal and policy frameworks are favourable; LFEWS establishment and maintenance is financially affordable to local government units; and, the social base, in terms of awareness and ability to co-own and maintain the system is strong. What needs further addressing is the ecological criterion in the strategic realm, particularly in spatial integration to land use planning. Otherwise, the recurrence of disasters in danger zones – if left unchanged in land use plans – will put stress on the ability of LFEWS to save lives and properties.

Acknowledgement

This material on LFEWS is mainly derived from the consultant report *"GIZ Local Flood Early Warning System (LFEWS): Understanding the Methodology, Examining Impacts and Learning Lessons"* by Ed Quitoriano, August 2012. The study was conducted to document the knowledge gained from the implementation of the GIZ Local Flood Early Warning System (GIZ-LFEWS) in Region 8. The content draws upon available documentation of the LFEWS experience in the three watersheds, namely Binahaan, Cadac-an / Bito and Pagsangaan in Leyte Island since 2007. Primary data were collected from key informant interviews, focus group discussions and insights from GIZ-EnRD staff.

LFEWS was financially supported by the European Community under the Directorate General for Humanitarian Aid (ECHO) within the Disaster Preparedness programme (DIPECHO) Action Plans 5 to 8, and the German Federal Ministry for Economic Development and Cooperation (BMZ).

Top reasons to establish LFEWS

1. **FEWS can be locally managed by** local governments.

2. **LFEWS effectively contributes to local disaster preparedness, response and early warning** by constantly monitoring and predicting where and when floods could possibly happen.

3. **LFEWS uses a watershed approach** and involves the coordination of local government units within the watershed.

4. **LFEWS is affordable,** costing between PhP1 to 2.75 million to establish and PhP500,000 to operate and maintain annually.

LFEWS Development and evolution in Region 8

"Years ago we associated floods with typhoons and rains but now flood disasters come even without a typhoon. We see dead cows and human corpses alongside floating logs from Mahaplag upstream. The banks of the Cadac-an River are collapsing and the waters are caving into our homes and farm lands."
Judith Aloyog, Barangay Captain of Can-Aporong, Abuyog Leyte

History of tragedies

At least three tragedies raised the curtain call for effective disaster preparedness and response before the introduction of LFEWS in Leyte island. These are:

Ormoc tragedy (November 5, 1991), in the wake of Typhoon Uring (International Name: Tropical Storm Thelma), the deadliest of the 1991 Pacific typhoon season. Roaring waters came down from the hills with logs and uprooted trees. At La Isla Verde, a sand strip at the mouth of the Anilao River and a place that should never have been inhabited at all, only 200 of 2,500 residents were evacuated safely. They formed part of the close to 5,000 human casualties from the floods that struck one third of the city.

Panaon Island tragedy (December 19, 2003), in Southern Leyte province affected 22 barangays in six municipalities (Liloan, Maasin, Malitbog, Pintuyan, San Francisco and San Ricardo), killing 154 individuals of the total 981 families affected and crushing 574 houses with flood and boulders from the mountains. (*BMZ Post Disaster Report of the Panaon Tragedy, Jan 26, 2004*)

The **2006 series of typhoons** (September 25 to December 9, 2006), hit the country within a span of 10 weeks, triggering widespread flooding and landslides. The most destructive being typhoon Reming, killing over a thousand people and destroying over 180,000 houses across 12 provinces (*WB-NDCC, Assessment of the Organizational Responses to the Dec 2006 Disaster*) and the February 17, 2006 mud-slide-avalanche in Guinsaugon (St. Bernard, Southern Leyte) in the wake of five-day heavy rains, ten smaller slides and a minor earthquake. More than 1,000 people died and a whole village disappeared from the local government map. Of the estimated 2,500 residents, only 1,500 were evacuated to safe locations (*DSWD*).

▲ Flood in Binahaan River, Leyte

The origins of LFEWS

From the period of 2005-2010, GIZ has been involved in achieving milestones in improving disaster risk management in the Philippines, in collaboration with both national and other international development agencies in disaster risk management. These were: the dissemination of General Weather Information Charts with the Department of Science and Technology (2005); participation in the 1st Public Consultation on the proposed DRM Act; Collective Strengthening of Community Awareness for Natural Disasters (SCAN) in watersheds and the READY Project (2006-2010).

The conceptual framework of LFEWS evolved from the Community-Based Flood Early Warning System (CBFEWS) of PAGASA in connection with the READY Project. There were key challenges recognized as barriers to effective disaster risk management. At the national level, disaster risk management measures were not yet mandated by law nor institutionalized; while at the local government level, they lacked the capacity to prepare their Disaster Risk Management Plans and the means to understand, gather and interpret data in the face of disasters.

LFEWS focus, therefore, is to empower local governments and communities in addressing flood disasters, enhancing their forecasting capacity and improving response capacity through early warning.

▼Affected communities in Abuyog and Ormoc during the 2011 heavy typhoons.

Disaster preparedness and early warning through a watershed approach

LFEWS recognizes that it is important to look at the whole watershed or river basin as a system to understand where all the water causing the flood comes from. Once river basins exceed their capacity, the excess water is spilled over to flat areas; and in a watershed system the upstream rain can cause flooding at the downstream area.

LFEWS can reduce casualties and damages to moveable property substantially. Basically, LFEWS detects a flooding condition upstream and warns inhabitants downstream of the approaching flood. The longer the time between the warning and the actual arrival of the flood, the better the residents can prepare by bringing their belongings and themselves to safe places.

LFEWS also has important links to land use planning. While the system directly supports communities in hazard zones that are not yet subject to zoning ordinances or are not covered by relocation plans, vulnerability maps and recorded incidences of floods may influence the issuance of zoning ordinances that prevent settlement in the most vulnerable areas.

LFEWS Policy settings and contributions

The Philippine experience in addressing disasters has evolved over time and most notably with regards to policies. From disaster preparedness in the 1970s, disaster management in the 1980s and to disaster risk reduction since 2005. By 2008, policies focused on the need to strengthen early warning and preparedness systems, as well as improve multi-stakeholder coordination.

The key relevant policies adopted and implemented since 2005, and their respective areas of actions, are summarized on **Table 1**.

A paradigm shift: from reactive to proactive DRR

The Strategic National Action Plan (SNAP) 2009-2019 was adopted in 2010 through Executive Order No. 888 (S. 2010) and this marked the paradigm shift from reactive to proactive disaster risk reduction response that is also linked to poverty alleviation and sustainable development.

It also suggests a change in disaster risk reduction from one that is purely technical to one that includes community participation, early warning, indigenous knowledge and land use planning.

The *Republic Act 10121 (RA 10121)* paved the way to provide the national framework and National Disaster Risk Reduction and Management Plan (NDRRMP) (2011-2018), and along this the change in the use of calamity funds and prioritizing the establishment of local flood early warning systems and how various disaster risk reduction and management programs are going to be funded. Prior to *RA 10121*, municipal governments did not have access to financial resources for disaster preparedness. The existing parameter for the use of the calamity funds was locked into disaster response, mainly for search, rescue and relief.

The NDRRMP priority areas point to one direction: reduce people's vulnerabilities and increase their capacities in dealing with disasters. The NDRRMP also defined the National Disaster Risk Reduction and Management Fund, Local Disaster Risk Reduction and Management Fund and Disaster Management Assistance Fund, among others, as fund sources to help attain the targets of the Plan.

Table 1. Key relevant disaster risk management policies adopted and implemented since 2005

Year of adoption	Key relevant policy or framework	Areas of priorities / action
2011-2018	National Disaster Risk Reduction and Management Plan	Identifies concrete actions for principles laid out in the National Disaster Risk Reduction and Management Framework. Among the priority projects are: • Establishment of local flood early warning systems (through integrated and sustainable management river basins and water sheds) • Development of guidelines on criteria / standards for local flood early warning systems • In Thematic Area 1: Disaster Prevention and Mitigation, Outcome 6 is defined as End-to-End monitoring, forecasting and early warning systems are established
2011	National Disaster Risk Reduction and Management Framework (NDRRMF)	• Risk knowledge (hazards, exposures, vulnerabilities and capacities) • Safer, adaptive and resilient communities towards sustainable development • Mainstreaming disaster risk reduction and climate change adaptation in planning and implementation. The framework also adopts the DRRM principles of sustainable development, community empowerment, responsive governance and mutually reinforcing partnerships, political will and commitment, local and customized adoption and adaption and addressing the underlying causes of vulnerability.
2010	Republic Act 10121 (Philippine Disaster Risk Reduction and Management (DRRM) Act of 2010)	An act strengthening the Philippine Disaster Risk Reduction and Management System, providing for the National Disaster Risk Reduction and Management Framework and institutionalizing the National Disaster Risk Reduction and Management Plan, appropriating funds therefore and other purposes
	Strategic National Action Plan (SNAP) 2009-2019	• Creation of an enabling environment • Financial and economic soundness through public-private partnerships and resource mobilization • Supportive decision-making for an enlightened citizenry through information and database generation and knowledge management • Safety and well-being enhancement through IEC, education and research and institutional and technical capacity building, forecasting and early warning • Implementation and evaluation of disaster risk reduction and corresponding development of tools for monitoring and assessment
2005	Four-Point Plan of Action for Disaster Preparedness (4PPADP)	• Upgrading the capability of two warning agencies – PAGASA and PHIVOLCS • Public information campaign on disaster preparedness • Capability building for LGUs and communities in identified vulnerable areas • Mechanisms for government and private sector partnership in relief and rehabilitation
	Adoption of the Hyogo Framework	• Disaster risk reduction as a national and local priority with strong institutional basis for implementation • Identification, assessment and monitoring of disaster risks and enhancement of early warning • Use of knowledge, innovation and education to build a culture of safe and resiliency at all levels • Reduction of underlying risk factors • Strengthening of disaster preparedness at all levels

LFEWS is a proactive approach to disaster risk management

Even before national policies made the shift to a proactive disaster risk reduction, GIZ played a significant role in exchanging knowledge on disaster risk reduction. GIZ convened the **1st National Conference on Mainstreaming Disaster Risk Reduction in Local Governance** (May 2007)[1] which spun into further dialogue processes and cooperation activities.

During the piloting stage of LFEWS in Binahaan in 2008, the pre-existing disaster coordinating councils then and the funds available to disaster risk management were mainly for disaster response operations not disaster preparedness. Despite this, GIZ initiated the formulation of the Disaster Preparedness Plans in the Binahaan Watershed. The Disaster Preparedness Plans were designed to be spatially and developmentally integrated into existing municipal government plans.

The call for integration of DRM plans into development plans

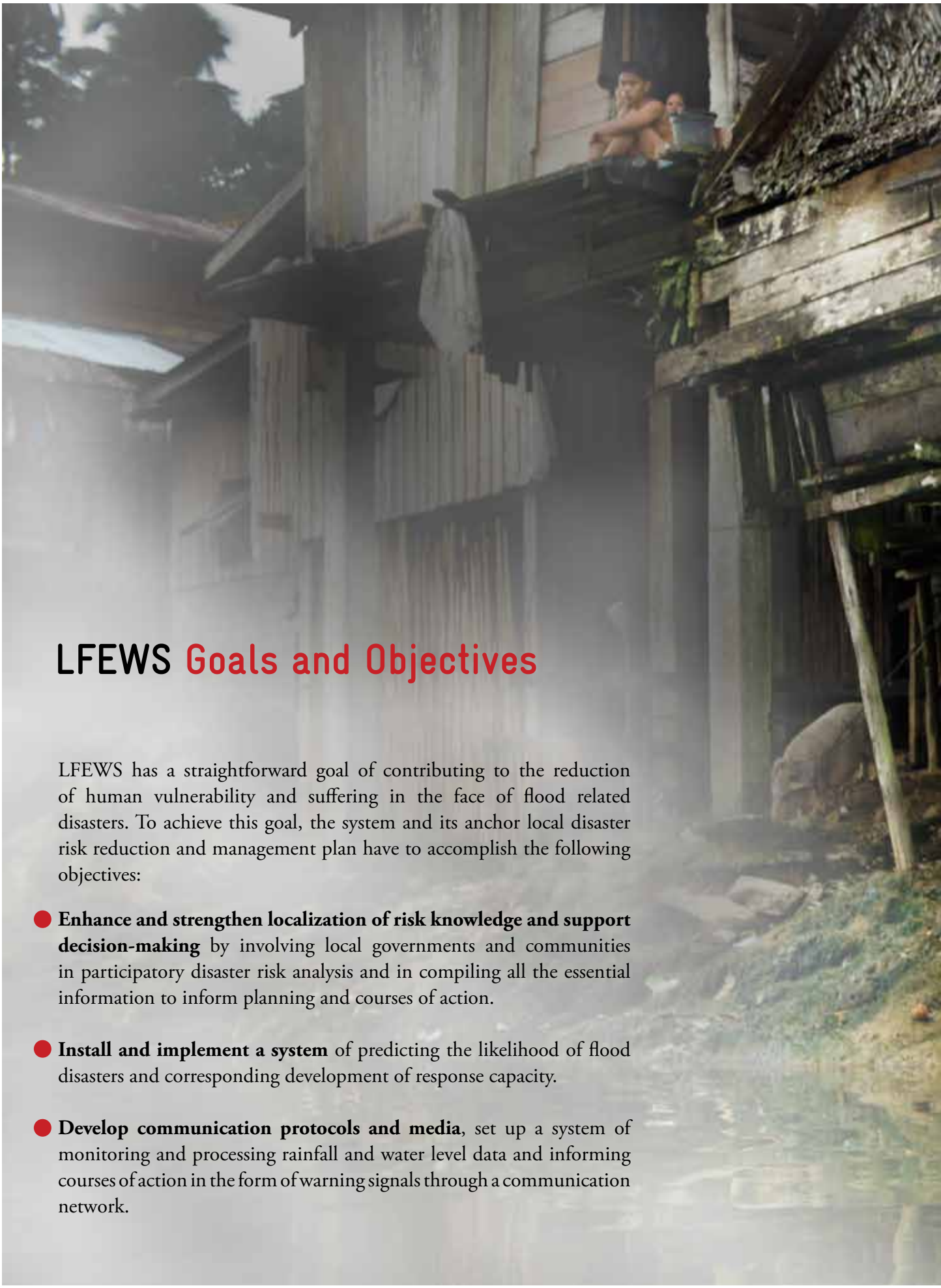
There is now a confluence of legal and policy frameworks and guidelines that link disaster risk reduction to climate change adaptation and mitigation. What needs further attention is to develop and strengthen Disaster Risk Reduction and Management institutions and in mobilizing resources by integrating disaster risk reduction into national and local land use and development plans (Comprehensive Land Use Plan (CLUP), Comprehensive Development Plans (CDP) and Annual Investment Programs (AIP)).

How DRM plan integration can be practically accomplished is described in another GIZ knowledge product called SIMPLE-Sustainable Integrated Management and Planning of Local Government Ecosystems.

1 In cooperation with DILG, DIPECHO, League of Provinces of the Philippines, UP Department of Geography and the Philippine Geographical Society

LFEWS

Goals & objectives • Definition & primary attributes • Four core components •
Stakeholders' roles • Minimum requirements of an operational LFEWS



LFEWS Goals and Objectives

LFEWS has a straightforward goal of contributing to the reduction of human vulnerability and suffering in the face of flood related disasters. To achieve this goal, the system and its anchor local disaster risk reduction and management plan have to accomplish the following objectives:

- **Enhance and strengthen localization of risk knowledge and support decision-making** by involving local governments and communities in participatory disaster risk analysis and in compiling all the essential information to inform planning and courses of action.

- **Install and implement a system** of predicting the likelihood of flood disasters and corresponding development of response capacity.

- **Develop communication protocols and media**, set up a system of monitoring and processing rainfall and water level data and informing courses of action in the form of warning signals through a communication network.

▲ Raul Lauderes, Operation Officer, DRRMO of Calbayog City Samar conducting a hazard assessment

LFEWS Definition and primary attributes

LFEWS means a watershed-based system managed by local government units and affected communities.

LFEWS' watershed approach refers to a 'ridge-to-reef' framework of natural resources management.

Pagsangaan Watershed

LFEWS has an integrated system of communication. Its Operation Center works 24/7 to monitor data on rainfall and river water level and issues the official appropriate alert signals to the communities.

LFEWS is a tool for empowering communities in partnership with their local governments. Affected communities co-own and participate in managing the system.

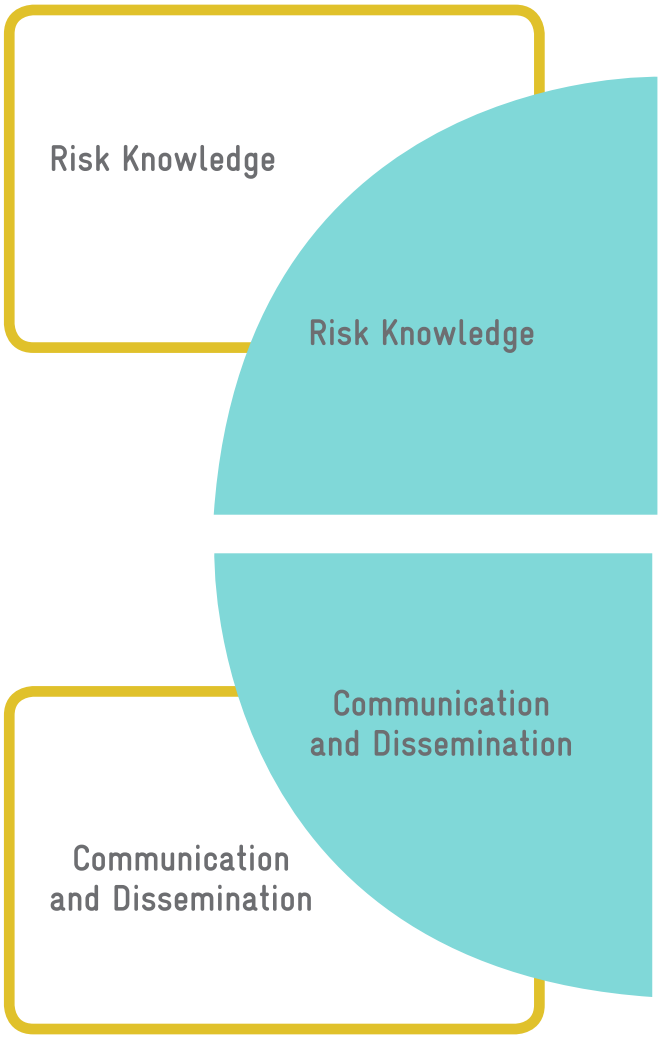
LFEWS empowers local governments to make informed decisions where and when needed and under conditions when higher level guidance or advisory is not available.

LFEWS integrates indigenous knowledge systems and practices, traditional local coping mechanisms such as this home-made bating-ting (bell) and modern technology in monitoring and forewarning.

LFEWS Four core components

LFEWS has four core components that coincide with the components of the **People-Centered Early Warning** (center circle) as prescribed in the *Republic Act 10121* or the *Philippine Disaster Risk Reduction and Management (DRRM) Act of 2010* (Section 3.Q) (**Figure 1**)

Fig. 1. LFEWS Components and Components of People-Centered Early Warning based on RA 10121 (Section 3.Q)



Risk knowledge

A risk is the combination of the probability of an event and its negative consequences. Risk takes into account both the impacts on a community when or should a hazard occur, and the capacity of individuals and communities to prepare or cope. Assessing risks includes a multitude of data concerning people and where they are situated.

By conducting a Participatory Disaster Risk Assessment, data such as these are gathered: estimates of how many people live and work in the flood prone area(s) and the moveable materials the households or businesses in the flood-prone area have; how many of the population are the most poor, how many have shelter that can withstand a flood, have children, elderly, handicapped; availability of gadgets like boats, vests, ropes, etc. Coupled with these are the data related to frequency of floods, and developing maps showing where the flooded areas are exactly and what the depth and current of floodwater is.

Monitoring and warning

Warning lies at the core of LFEWS. The best data for predicting a flood is measuring the water level of the river. The second best way is predicting a flood from rainfall data. LFEWS uses both and the system operates 24 hours a day. The variability of rainfall and river water levels are processed and converted into warning signals to inform courses of action in the form of warning signals.

Detection of a flood condition upstream and the arrival of the warning at the inhabitants of the flood-prone area take time. This time depends on how frequent the data is gathered, the communication of the data to an operation center, the decision to issue a warning and the communication of the warning to the households (possibly via a chain). A very fast system may need only 10 minutes for this, but under normal circumstances many households may be informed only after 30 to 60 minutes, some even later.

Communication and dissemination

This mainly consists of an effective communication network that serves as platform for risk monitoring data and alert signals using radio, mobile telephony and indigenous and traditional communication media such as bells (bamboo and iron), megaphones and human communicators (neighborhood "rondas") on foot, on horseback or motorbike who and which can communicate warning levels to the communities.

Response capability

Forming part of the system but usually coordinated with other units of the local Disaster Risk Reduction and Management Offices and external aid organizations, response capability pertains to humanitarian actions during worst-case scenarios such as search and rescue, evacuation and emergency assistance.

LFEWS Stakeholders' roles

With the enactment of the *Republic Act 10121* or the *Philippine Disaster Risk Reduction and Management (DRRM) Act of 2010* and its implementing rules and regulations and accompanying administrative orders and memorandum circulars from relevant national agencies, the collaboration of the following key stakeholders (**Table 2**) are important for an LFEWS to function well.

Table 2. Key stakeholders of LFEWS

Institution	Objective
The Provincial Disaster Risk Reduction Management Councils (PDRRMC) and their counterparts at the lower levels, the City / Municipal Disaster Risk Reduction and Management Offices and the Barangay Development Councils	Among its functions are disaster risk monitoring, establishment as well as operation of multi-hazard early warning systems.
The Provincial Disaster Risk Reduction Management Office (PDRRMO) and its local counterparts at the city / municipal and barangay levels	Act as the executing agencies of the disaster risk reduction and management councils and are mandated to operate local early warning systems.
The Local Chief Executives of cities / municipal and barangay levels	The chairpersons of local disaster risk reduction and management councils and are specifically mandated to establish early warning and alert systems and evacuation procedures and make decisions, including forced evacuations when warranted by conditions (DILG Memorandum Circular 2012-08, January 12, 2012) and suspension of classes and work in government offices (Executive Order No. 66, S. 2012).
Operations Center (OPCEN)	As a task unit within a municipality, city or province and shall act as 24/7 data center and anchor of the monitoring and alert communication system.
Local Volunteer Observers (LVOs)	Observe and transmit data on rainfall, river water levels and other flood risk sources and ensure the security and protection of rain and water level gauges.
Schools	Their facilities often serve as temporary evacuation centers and whose teachers and students often assist in information dissemination and raising public awareness.
Affected communities	The social base of LFEWS, are both the beneficiaries from the early warning and also assist in system maintenance and dissemination of alert information and development of community response capacity.
Office of Civil Defense (OCD) or its nearest regional unit	The Office of Civil Defense is the implementing arm of the National Disaster Risk Reduction Management Council and lead agency for Disaster Risk Reduction Management planning, implementation of national standards and operating procedures of disaster risk reduction. Their functions also include preparedness programs, such as standard operating procedures of alert communication systems. The Office of Civil Defense also have the power to review and evaluate local DRRM plans and programs. (Rule 7, IRR of Republic Act 10121 or the Philippine Disaster Risk Reduction and Management (DRRM) Act of 2010).
Department of Science and Technology (DOST) or its nearest regional unit	The DOST is the Philippines' premier agency for directing, leading and coordinating all scientific and technological activities and could provide technical support for LFEWS product development.
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	The meteorological arm of the DOST and source of national weather updates, typhoon and rainfall forecasts and alert warnings. The agency issues bulletins for rainfall and water level in selected areas of the country like Metro Manila.

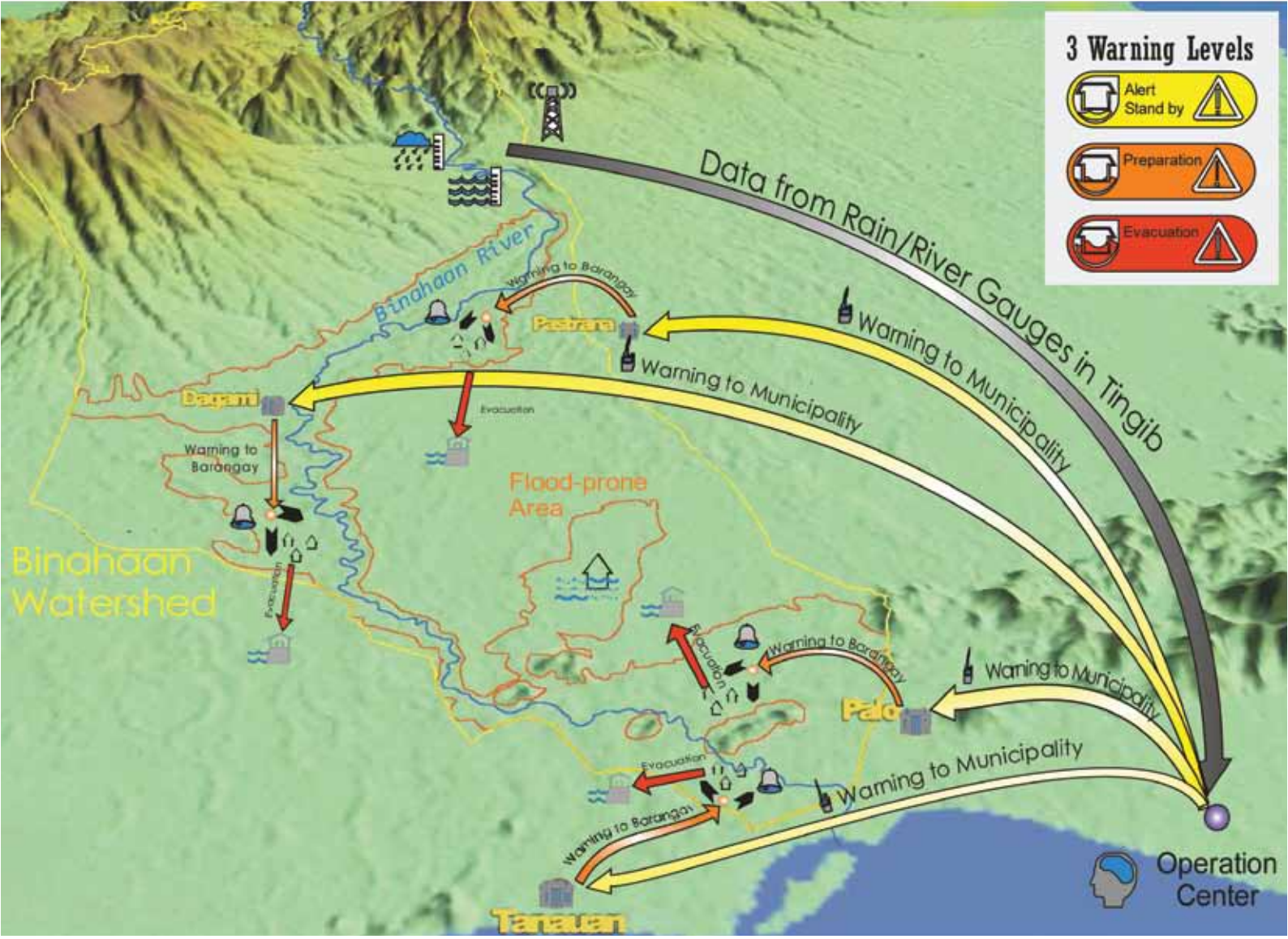
Role of GIZ

GIZ acts as a facilitating agent for capacity development, technical support and institutional strengthening for disaster risk reduction management. GIZ recognizes that DOST-PAGASA has taken care of installing early warning systems in major river basins with flood prone areas. However, these systems are technically demanding, highly automated and require heavy investments. The operations center, where information is gathered and decisions are made, is located in the office of PAGASA.

For smaller rivers and smaller flood-prone areas, GIZ initiated the LFEWS, whose technical set-up is less sophisticated and thus much cheaper. The operations center is based locally, in or near the flood-prone area and staffed with local personnel. The local government unit and communities are strengthened to interpret rainfall and river level data which are observed and reported to their local operations center. Automated gauges play a key role in the system and are augmented by local observers (mostly volunteers). In the experience of the local partners of GIZ (provincial government, municipalities) the system can forecast flood events and warn people in the hazard zone reliably.

Since 2006, GIZ partnered with DOST-PAGASA on flood hazard mapping and introduction of rain gauges.

In 2007-2008, it conducted Participatory Disaster Risk Assessments and the formulation of Disaster Preparedness Plans in the Binahaan and Pagsangaan watersheds. These studies represented a key step in the piloting of LFEWS.



▲ Binahaan Watershed Flood Early Warning System Communication Flow

Minimum requirements of an operational FEWS

The minimum requirements of an operational FEWS depend on the size of the watershed. The technical requirements – the equipment and facilities – are adjusted according to at least four considerations:

- The number of sub-river systems and sub-basins
- The number of strategic locations and river choke points where the rain and water level gauges need to be installed
- The spread of vulnerable communities that accounts for estimating the equipment and capacity of the communications network
- The number of local government structures that form part of the system

Table 3 indicates the minimum requirements of an operational LFEWS based on the magnitude of the watershed with essential consideration pertaining to the number of sub-river systems and sub-basins.

Table 3: Cost of the minimum requirements per type of watershed of an operational LFEWS

Cost Items	Unit Cost (2009) (PHP)	System Size					
		Large		Medium		Small	
		Qty	Amount	Qty	Amount	Qty	Amount
Telemetered Rain Gauges	220,000	3	660,000	2	440,000	1	220,000
Telemetered Water Pressure Gauges	450,000	3	1,350,000	1	450,000	1	450,000
Digital Rain Gauge	7,000	3	21,000	2	14,000	1	7,000
Manual Rain Gauge	7,000	1	7,000	1	7,000	1	7,000
Water Level Marker	1,000	8	8,000	6	6,000	4	4,000
Data Center (Solar Power, Early Warning Software, RF Transmitter)	165,000	3	495,000	2	330,000	1	165,000
Back-up PC for Data Centers	20,000	3	60,000	2	40,000	1	20,000
Automatic Weather Station	45,000	1	45,000	1	45,000	1	45,000
Base Radio	20,000	3	60,000	2	40,000	1	20,000
Handheld Radios	10,000	6	60,000	5	50,000	5	50,000
Total			**2,766,000**		**1,422,000**		**988,000**

Establishing LFEWS is affordable

An LFEWS for a watershed with one sub-river system and one sub-basin will cost roughly PhP1 million to establish; a similar system for a watershed with two sub-river systems and two sub-basins will cost around PhP1.5 million; and a similar system for a complex watershed that includes more than two sub-river systems and sub-basins will cost around PhP2.7 million.

The other key costs consist of research, IEC, capacity-building and operations and maintenance (see **Annex 1**, Tables 1-3). These costs vary depending on the size of the watershed, number of flood prone barangays and availability of risk knowledge and disaster preparedness plans.

LFEWS

Process model for establishment • Operations • System maintenance • Obstacles and limitations

LFEWS Process model for establishment

Establishing LFEWS can be described as a five-step process. The steps are not all technical in nature, but also include legal, administrative and social processes. It is also important to note that LFEWS is a flexible system and once systematic and standardized processes are in place, these can be continuously adjusted as trends on hazards and vulnerabilities change (e.g. deforestation in a watershed resulting in faster run-off, climate change resulting in stronger rain).

1

Secure political consent of local governments and social acceptance at community level

- Dialogues and consultations
- Coordination with relevant national agencies and local offices (like DOST, OCD, PAGASA, NIA and water districts)
- Initial assessment of disaster areas
- Forging of Memorandum of Agreement with concerned local government(s)

2

Conduct Participatory Disaster Risk Assessment (PDRA)

- Disaster History
- Hazard assessment
- Risk perception
- Vulnerability and capacity assessment
- Traditional coping mechanisms

3

Planning and integration of LFEWS to existing disaster plans and structures

- Agreement on warning levels
- Agreement on communication protocols
- Formulation of the Disaster Preparedness Plan
- Local government adoption of Disaster Preparedness Plan and integration to existing Comprehensive Development Plan
- LFEWS integration to the Annual Investment Plan
- Institutional set-up
- Training
- Formulation of monitoring and evaluation tools

4

Hardware installation and calibration

- Calibration of monitors and communication equipment
- Dry run and drills
- Post-event validation / recalibration of monitors and equipment
- Continuing refinement of protocols

5

Implementation

- Functioning Operations Center (OPCEN)
- 24/7 disaster monitoring
- Systems maintenance
- Hardware maintenance
- Coordination
- Resource generation
- Re-training

1 Secure political consent at the local government level and social acceptance at the community level

LFEWS should be demand-driven. Although its relevance and use value to local governments and communities are self-revealing, political consent and community acceptance need to be secured and reaffirmed at the onset.

Securing political consent is contextual. LFEWS could come as a natural add-on in areas where there are pre-existing development partnerships without need of a formal agreement. In areas where the supporting party is still developing a relationship, a Memorandum of Agreement (MOA) may be necessary. Community acceptance, on the other hand, is not difficult to get. However, it is best to reaffirm with local citizens, since some people, even in most vulnerable areas, still cling to the "*bahala na*" (leave it to fate) attitude.

In parallel, the supporting party, local government partner and target communities should jointly conduct an initial assessment of the disaster areas as reference of the formal or informal agreement. Also in parallel, the supporting party and the local government partner should coordinate with PAGASA, Department of Science and Technology and the Office of Civil Defense to map out areas of cooperation and make use of existing data.

2 Conduct Participatory Disaster Risk Assessment (PDRA)

Disaster risk assessment is best done with the involvement of local government units together with the communities. The participatory aspect enables the development of clear objectives and transparent information for making decisions that can reduce disaster risks.

This step involves identifying, analyzing and determining how the community will manage disaster risks. A review of disaster history is done as well as the conduct of several assessments. The assessments are on: hazards, risk perception, vulnerability and capacity.

Step 2 enables them to:

- Establish the disaster risk context
- Identify the disaster risks
- Analyze the disaster risks
- Prioritize the disaster risks
- Determine means of monitoring and communication

Also taken into account are the existing traditional or local coping mechanisms. Using traditional systems recognizes the importance of well established roles and responsibilities of different members of the community and the existing knowledge, methods (such as utilizing the use of church bells for setting off warning alerts), skills and capacities of community members.

Flood scenarios could be created by utilizing the community-based flood maps and also by making use of existing hazard maps from the Mines and Geosciences Bureau (MGB) (http://gdis.denr.gov.ph/mgbviewer). MGB hazard maps only show flood-prone areas. By adding the socio-economic data, such as that from Community-Based Monitoring System, allows for a more detailed understanding of the elements at risk, such as the number and kind of infrastruture, services, agriculture and population, in a given area.

3 Planning and integration of LFEWS to existing Disaster Plan or Disaster Risk Reduction and Management Plans and structures

The LFEWS planning scenario could vary according to prevailing conditions at the local government level. In some areas, there may be pre-existing Disaster Preparedness Plans or Disaster Risk Reduction and Management Plan that are integrated into the Comprehensive Development Plans and Annual Investment Plan of the municipal government.

LFEWS needs an anchor – either a Disaster Preparedness Plan or a Disaster Risk Management Plan. It also needs an over-arching steering structure that could already be present such as a Provincial Disaster Risk Reduction Management Office or their equivalents at the city, or municipal level.

4

Hardware installation and calibration

▲ LFEWS conducts local community dry run and drills

An operational LFEWS require the following equipment and preparations:

- Installation and calibration of monitors and communication equipment
- Dry run and drills
- Post-event validation and calibration of monitors and equipment
- Continuing refinement of protocols

The quantity and spread of the equipment will vary according to the:

- Size of the watershed and number of sub-river systems and sub-basins
- Quantity of strategic rain and water gauge stations to be monitored
- Number of vertical and horizontal layers of communication

Basic FEWS hardware set-up require only three major hardwares: one rain gauge, one river-level gauge and one data receiver for the Operations Center. These devices collect data and provide readings which are transmitted to the Operations Center via an automatic or manual radio.

The most reliable way of predicting a flood is observing the river level upstream from the flood-prone area. A minimum set up is to have two river level gauges: one upstream to be able to warn before the flood comes and one in the river where the flood occurs.

Hardware installation should be tailored fit to a flood prone area to ensure more precision and reliability in forecasting the expected arrival time and height of a flood.

▼ Automatic gauge (protected with old tires) and transmitter in St. Bernard, Southern Leyte

5

"Our data center at the OPCEN operates 24/7 with a reserve PC in case the main computer fails. Our warning usually gives affected communities a five-hour preparation time prior to Level 3 rise of river water elevation. But during the simulated evacuation drills, people could actually prepare themselves in 45 minutes."
Paul Mooney, Focal Person, OPCEN of the Binahaan Watershed

Implementation

This step is the final phase of LFEWS installation and the first phase of an ideally sustained LFEWS operation and maintenance. Effective implementation requires the following:

Operations Center
The Operation Center or a command center processes monitoring data and is the designated and authorized office that sends out warnings to affected communities through a pre-established communications network. Ideally, the Center should be dedicated only for LFEWS. In some cases, however, the Center could be more comprehensive, including search and rescue, evacuation and relief operations. What is important is that for any type of Operation Center, there should be a dedicated staff for LFEWS.

24/7 disaster monitoring
LFEWS establishes water level and rainfall devices which provide data that are observed, recorded and transmitted to the Operation Center. In case the forecasted path of the weather disturbance is within 500km of the watershed, it is wise to check that these devices are properly working and local observers are available and ready to do their meter readings. After the Operation Center has decided to issue the warning, it is essential that the communications network is followed so that there is a clear flow of information.

Systems maintenance
Wear and tear afflicts not only equipment but also the human resources dedicated to monitor the gauges or operate the system. Organizational maintenance should come alongside hardware maintenance.

▲ Automatic weather station

Coordination with Disaster Risk Reduction Management agencies. The local disaster risk reduction and management office or Operations Center can touch base with the national / regional agencies such as the OCD, DILG or DOST and its services and research institutes (e.g. PAGASA or PHIVOLCS), to be part of a growing network of disaster risk management practitioners that tap and contribute to each others' learning and resources.

Political, policy and administrative support
Political turnovers may have negative effects to LFEWS implementation and deciding to sustain it or not may emerge both at the level of the command center and at the community level. It would be best to institutionalize LFEWS with adequate policy coverage such as executive orders, budgetary allocation or integration in local development plans.

It should be noted that LFEWS implementation is not a purely technical process. It has political and social dimensions.

Legal and Administrative Processes

THERE SHOULD BE CLEAR LINES OF ACCOUNTABILITY IN ORDER FOR LFEWS TO BE SUSTAINED.

LFEWS development came alongside the evolution of the legal and policy frameworks in disaster risk reduction and management. It is expected that the roll out of national policies and guidelines will have varying applications at the local government level.

In whatever way LFEWS comes into being, there should be clear lines of accountability in order for LFEWS to be sustained. Policy and political environment needs to be favourable and communities who adopt it must have a sense of ownership over the system. To see is to believe, thus if LFEWS continues to save lives and properties, the community support and ownership of the product will also continue.

In Leyte, the Provincial Government designated at least three full time staff to the LFEWS Operation Center of Binahaan Watershed under the Provincial Disaster Risk Reduction and Management Office.

THERE IS AMPLE ROOM FOR AFFECTED COMMUNITIES TO PARTICIPATE IN ALL OF THE STEPS AND TRANSFORM THEMSELVES FROM PURE VICTIMS OF DISASTERS TO ACTIVE PARTICIPANTS IN RISK REDUCTION AND MANAGEMENT.

Social Processes

LFEWS is also a tool for community empowerment. Community ownership and participation is important from inception, system installation and implementation. There is ample room for affected communities to participate in all of the steps and transform themselves from pure victims of disasters to active participants in risk reduction and management. Some community members play critical tasks such as disaster awareness campaigners, gauge readers and monitors, communicators or evacuation drill facilitators. They also provide security to the rain and water level gauges.

In the experience of affected communities in the Binahaan watershed, LFEWS tends to reinforce community coping mechanisms and household strategies for responding to calamities. The lead time prior to Level 3 water rising and evacuation signal allows families to activate their response plans.

▲ The Operation Center in Palo Leyte for the Binahaan Watershed FEWS with visitors

LFEWS Operations

Organizational structure

At the heart of LFEWS is **the Operations Center (OPCEN)** that contains the data center and communications hub. It is operated by at least three specialists :

- Focal Person
- Radio Specialist
- Disaster Response Specialist

These three coordinate with other units during emergencies. The OPCEN is located within a Disaster Risk Reduction and Management Office (DRRMO) of host province or municipality which, on the other hand, is the executing arm of a local Disaster Risk Reduction and Management Council. In the Binahaan LFEWS, the Center is within the Provincial DRRMO; in the Pagsangaan Watershed, it is located within the still-to-be formed City DRRMO of Ormoc; and, in the Cadac-an / Bito Watershed, it is currently hosted by the Municipal Development Planning Office since the Municipal DRRMO has yet to be organized.

An OPCEN within a DRRMO may have multiple functions where the LFEWS merely forms part of the overall structure. In the Municipality of

Palo, for example, the Municipal DRRMO has designated an LFEWS Focal Person who coordinates with the Binahaan Watershed LFEWS OPCEN.

Based on the results quadrant prescribed in the National Disaster Risk Reduction Management Framework, LFEWS is located in the second element – preparedness. In addition to preparedness, the structural configuration of the DRRMOs also addresses the other element of the quadrant – response. In the Municipality of Palo, the LGU has designated a 10-member Municipal Disaster Response Team whose tasks include flood early warning and search and rescue.

"Our monitoring and alert warning systems for Levels 1, 2 and 3 used to correspond to the "ready, get set and go" sequence. Recently, however, we decided to issue evacuation signals at Level 2 of water level monitoring. Issuing the evacuation signal only at Level 3 is useless because people no longer have time to prepare. Level 3 is already for search and rescue."
Rafael Vincent Mooney, Focal Person of the Palo
Municipal Disaster Risk Reduction and Management Office

LFEWS Flood alert and warning levels

The Binahaan Watershed LFEWS uses three colors to communicate warning and alert levels:

- **Yellow** for Flood Level 1 and Standby
- **Orange** for Flood Level 2 and Preparation
- **Red** for Flood Level 3 and Evacuation

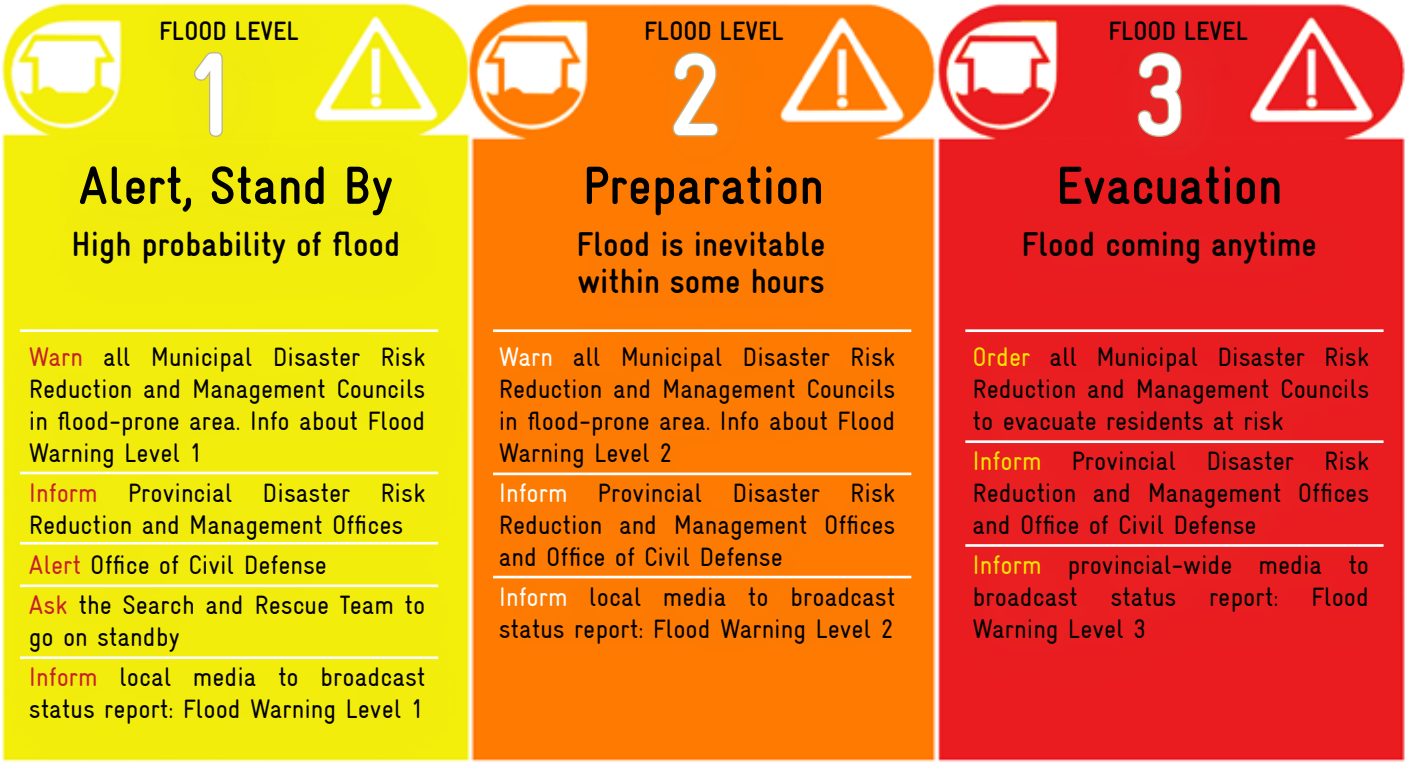


Figure 2: The three colors of FEWS' warning and alert levels

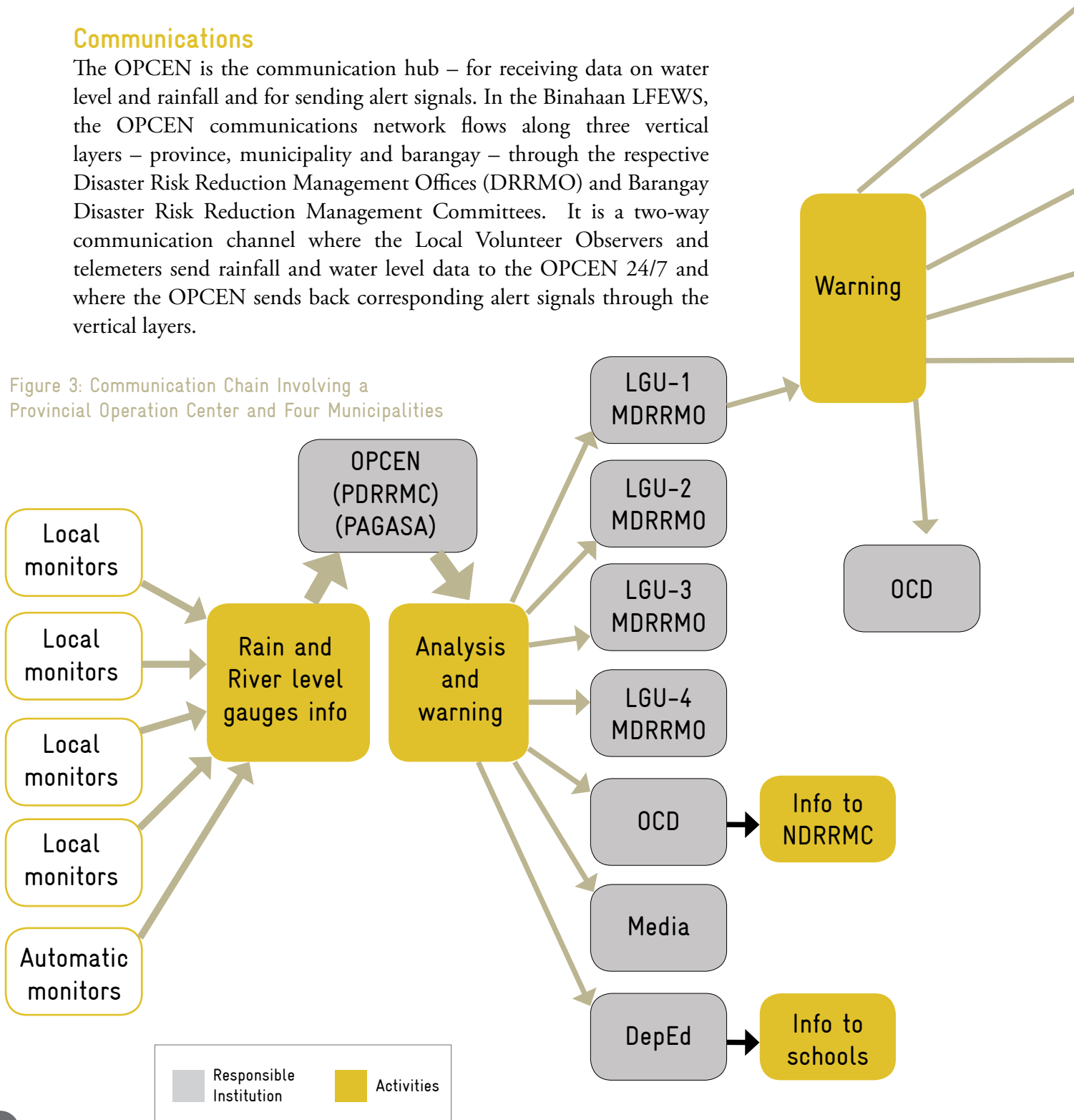
Although the correspondence between flood levels and alert warnings remain in the documentation reports, recent practice suggests that the Evacuation Signal (Red) is raised at Level 2 (Orange) of the flood warning[2]. This practice is derived from actual experience where raising the evacuation signal only at Level 3 of flooding negates the value of early warning and pulls the alert warning into a search and rescue operation.

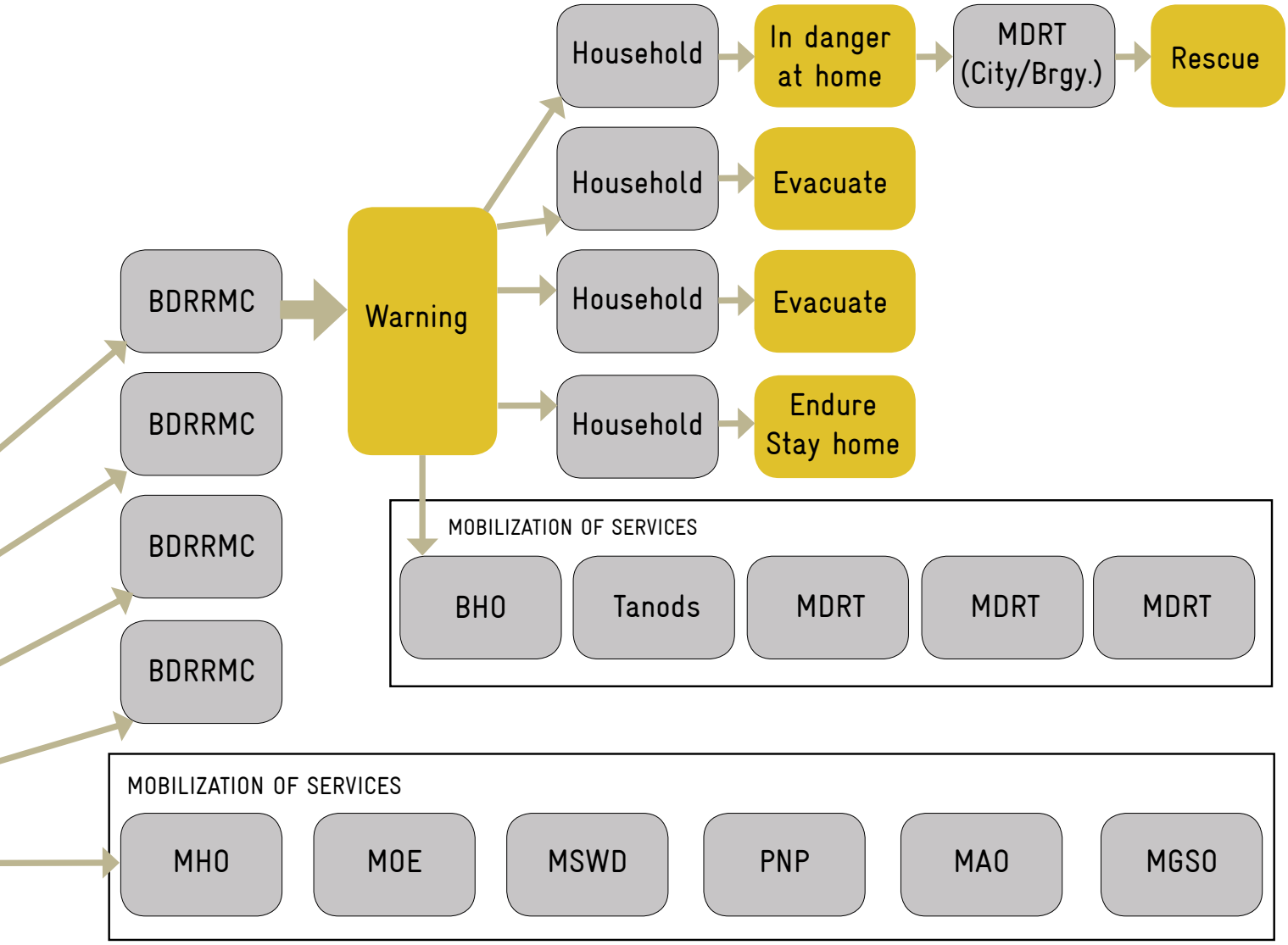
The LFEWS flood and alert signals and symbols are already adopted in Leyte island, it may need to be harmonized to emerging national and international standards and procedures.

Communications

The OPCEN is the communication hub – for receiving data on water level and rainfall and for sending alert signals. In the Binahaan LFEWS, the OPCEN communications network flows along three vertical layers – province, municipality and barangay – through the respective Disaster Risk Reduction Management Offices (DRRMO) and Barangay Disaster Risk Reduction Management Committees. It is a two-way communication channel where the Local Volunteer Observers and telemeters send rainfall and water level data to the OPCEN 24/7 and where the OPCEN sends back corresponding alert signals through the vertical layers.

Figure 3: Communication Chain Involving a Provincial Operation Center and Four Municipalities



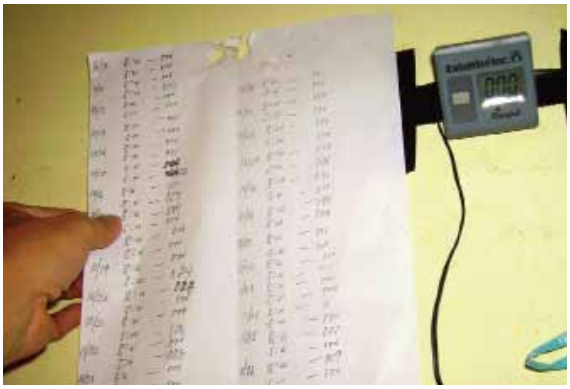


ACRONYMS

BDRRMC	Barangay Disaster Risk Reduction Management Committee
BHO	Barangay Health Office
DOST	Department of Science and Technology
DepEd	Department of Education
DPWH	Department of Public Works and Highways
OPCEN	Operations Center
LGU	Local Government Office / Unit
MAO	Municipal Agricultural Office
MGSO	Municipal General Services Office
MDRRMO	Municipal Disaster Risk Reduction Management Office
MDRT	Municipal Disaster Response Team
MHO	Municipal Health Office
MOE	Municipal Office of the Engineer
MSWD	Municipal Social Welfare and Development Office
NDRRMC	National Disaster Risk Reduction and Management Council
OCD	Office of Civil Defense
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PDRRMC	Provincial Disaster Risk Reduction Management Council
PNP	Philippine National Police

The most common medium is amateur radio on the VHF channels, complemented by mobile phone and SMS. At the municipal DRRMO, support personnel use motorbikes to disseminate information in cases where mobile telephony and radio fail to reach out to the intended targets. At the barangay level, communities activate indigenous media such as bells (acoustic signal) and "radio baba" or word of mouth communications.[3]

2 Interview with Rafael Vincent Mooney, LFEWS Focal Person, PALO MDRRMO, 21 July 2012.
3 The acoustic signal from bells also has three levels: one ring, long pause and repeated, for Level 1; two rings, long pause and repeated for Level 2; and, continuous rings for Level 3. (Source: GIZ LFEWS Manual, 2011).



Personnel Requirements and Expertise

The LFEWS Operation Center, like the one for Binahaan Watershed, consists of the following personnel:

Three Core Staff

The core staff requires expertise in computer software, radio communications protocols and standards, alert procedures and protocols, data management, organizational management and political savvy in handling local executives.

Support Staff (variable in number)

The support staff requires a range of expertise that includes radio and non-radio communications, evacuation procedures, search and rescue and other disaster preparedness and response capabilities.

Community-based Volunteer Observers

Observers read and report data from the rain and water level gauges. They are needed only for the manual gauges, currently five. The Community-based Volunteer Observers, on the other hand, require basic knowledge in metric reading and calculation, security, communication (radio, SMS and voice) as well as minor repairs.

LFEWS System Maintenance

The system of maintenance of LFEWS underlies two major dimensions: financial and social.

Financial Dimension

There are administrative (civil service rules and regulations) and budgetary (Department of Budget and Management guidelines and approval) constraints in the structuring and financing of LFEWS. However, in the Binahaan experience, the Provincial and Municipal local governments have, in the interim, overcome these constraints through temporary designation of staff and utilization of their existing salary items. Local governments also reinforce the systems maintenance requirements with the so-called "job orders" or utilization of contractual staff for LFEWS support services requirements.

This coping strategy is not without risks of losing skilled contractual personnel or personnel turnover arising from changes in the attitude of elected officials.

Social Dimensions

There are a number of considerations pertaining to the maintenance of LFEWS at the community level:

Differential impact of disasters

The same volume, force and depth of flood will produce different damages (impacts) to an area because of different coping capacities or lack of it in a given community. Poor people are most vulnerable because most often their economic and physical condition render them least able to cope in such situations.

Link to spatial planning and land use

Spatial planning and land use define and delineate which areas are least risky and should be avoided for residential development if communities are to be safe and protected from natural hazards. It will also define what crops are to be avoided or mitigation measures that needs to be engaged to prevent losses in production and the ensuing loss in revenues and employment.

While LFEWS can save lives and properties, the repeated evacuation of a certain group of people, most often the poor, everytime a flood occurs does not make sense. The areas they live on would have to be declared through a local ordinance as danger zones, and the people would have to be relocated.

Developing and sustaining community response capability

After a new LFEWS is established, it is a good practice to familiarize all stakeholders with the system and how it performs. By having mock exercises (drills and dry runs) executed in "near real" situation of an approaching flood, all involved stakeholders can therefore know what is the proper response they can take. It is essential to observe and document such events to determine shortcomings with regards to: how the warnings are respected and followed and how long a certain step takes (i.e. distance to evacuation area). It is essential to recognize also that aside from empowering individual and household response to disasters, it is equally important that they (residents and response institutions) also know what to do together.

▲ A household conducts a mock exercise on what to prepare during an emergency

LFEWS Obstacles and Limitations

Administrative processes

A key obstacle to the institutionalization of LFEWS is slow pace of the rollout of the Implementing Rules and Regulations of the *Republic Act 10121* or the *Philippine Disaster Risk Reduction and Management (DRRM) Act of 2010* and in parallel, delays in local governments interpretation of this law.

The pace of transformation of local disaster coordinating councils to local Disaster Risk Reduction and Management Councils and corresponding creation of Disaster Risk Reduction and Management Offices, have been slow and uneven. It is already two years since the enactment of *RA 10121,* but some local governments have yet to formally establish their Disaster Risk Reduction Management Offices and clarify the budget allocations. With such delays, the LFEWS mechanisms – such as the Operation Center – have been literally held in some kind of temporary holding areas such as the Office of Barangay Affairs or the Municipal Planning and Development Office. On the other hand, local governments have yet to overcome civil service and budgetary barriers in the structuring of the Disaster Risk Reduction Management Offices and LFEWS.

Overall, *RA 10121* demands local governments to establish interim Disaster Risk Reduction and Management Offices and designate staff. However, most of the major mitigation and prevention measures and capacity building costs can still be funded under a local government's development fund falling across the five key development sectors.

Technical limitations at the local government level

While telemetering enables 24/7 transmission of the rain and water levels to the data center, the technology is largely in the hands of the private company that developed the innovation. Damages that require major repair of equipment need to be attended to by the Manila-based service provider.

Limitations at the Volunteer-Observer level

The volunteers incur opportunity costs and face hazards in doing their job. As yet, there is no formula on what kind of incentives to offer to strengthen their volunteerism. Secondly, some are vulnerable to political turnovers at the barangay level. In some cases, the existing volunteers are replaced due to the preference of new barangay officials.

Limitations at the community level

In some flood-prone barangays there are families that continue to reside in danger zones that are supposed to be permanently evacuated. They are chronic targets of early warning and search and rescue all together during flood events. Absence of land use and relocation plans put stress on early and disaster response resources.

LFEWS

Gains achieved and actual benefits • Co-benefits • Success factors • Lessons learned

LFEWS Gains achieved and actual benefits

The biggest achievement of LFEWS in Region 8 is the localization of risk knowledge and disaster response decision-making in the hands of local governments. The ability of local governments and communities to protect lives and safe-keep properties where and when disaster floods actually happen has contributed to the global goal of reducing human misery against disasters. The experience has also demonstrated the feasibility of creating and strengthening Disaster Risk Reduction and Management institutions at the level through a simple and affordable technical innovation in early warning.

> " There was no typhoon but it was raining intermittently for several days. The water level of the creeks was rising. At that time, the mobile phones were not working. The guys from OPCEN in Palo came on motorbikes to announce the signal. Our teacher announced the suspension of classes upon getting the message from the Barangay Captain. We had five hours to prepare. My father fetched me from school then our family activated our emergency plan. I collected the clothes, my mother collected the rice and kitchen utensils, my sister collected our shoes, my brother went to my grandmother's house to help her, my father herded the livestock to the bridge for safety and my youngest sister guarded our belongings on the second floor of our house. The water subsided two days later. No one was hurt and we saved our most important belongings. It is good to be forewarned."
>
> Sharmela Margallo, 13 year-old Grade VII pupil, describing the flood event in Cangumbang, Palo (Leyte) on 26-27 December 2011 and how her family benefited from LFEWS.

Saving lives and properties

The agriculture, social welfare and health offices of municial governments usually collect damage reports after each disaster event. The number of lives saved is currently limited to those recorded in the evacuation centers but these figures account as hard, albeit partial, data on number of lives saved. Primary accounts from affected communities suggest a higher figure. Some examples are provided below:

December 26-27 floods in Brgy. Cangumbang (Palo, Leyte):

- 200 lives and their properties saved after having been given ample warning according to affected communities while 64 lives saved in the evacuation center (*DSWD*)

Binahaan watershed

- From 2010-2011, their LFEWS signaled / raised four alert level 3 (Evacuation); eight alert level 2 (Preparation); and 11 alert level 1 (Stand-by). Stakeholders cite the fact that they have not lost any life since they used the system.[4]
- During the February 13, 2012 flood, 40 families (158 persons) received early warning and had evacuated in time to four evacuation centers and all returned home safely. (*Binahaan Operation Center post-disaster report*)

4 FGD with LGU officials from Palo, Pastrana, Tanauan and Dagami (Binahaan Watershed), 20 July 2012.



Reinforcing community coping mechanisms and strategies

The utilization of LFEWS has reinforced local coping mechanisms and strategies. The availability of LFEWS reinforces the traditional arrangements and give time for the evacuees to collect food for three days, clothing, drinking water, firewood, matches and candles and secure their livestock in temporary shelters. Below are some citations from affected communities.

Barangays of Tingib and Yapad (Pastrana) and San Jose (in Dagami)

- Communities have traditionally sought the assistance of better-off families in giving shelter to evacuees. For example in Pastrana, three well-off families traditionally accommodate five other evacuee families during floods. While in Dagami, 13 better-off families traditionally accommodate 32 other evacuee families during floods.
- A Pastrana trader has traditionally offered his two trucks to transport evacuees to safe locations.

Enhancing indigenous knowledge systems and practices

The introduction of LFEWS gauges enables communities to actually measure their observations into metric data that could be sent to the Operation Center for processing and conversion into alert signals. The process of monitoring, collection, sending and processing of disaster data feed into the larger process of strengthening community level coordination and inter-group support.

Alongside the technical manner of monitoring, communities continue to depend on their indigenous knowledge of their surroundings, such as:

Pastrana and Dagami (Binahaan Watershed)

- Predict the occurrence of floods by looking at signs such as red color of river beds
- Dark clouds and heavy rains
- Presence of algae in the waters
- Sulfuric odor of water
- Unusual noise of frogs or ants and millipedes climbing into homes

LFEWS Co-benefits

LFEWS was implemented in Region 8 at a time when the legal framework of Disaster Risk Reduction and Management was still evolving. Looking at the provisions of the *Republic Act 10121* or the *Philippine Disaster Risk Reduction and Management (DRRM) Act of 2010* and other relevant issuances of the national government, LFEWS has advanced its contributions to national policies. These contributions include the following:

Indirect contributions to at least two aspects of the NDRRMF results quadrant, namely: (a) prevention and mitigation – pertaining to specific outputs and tools in Disaster Risk Reduction assessment, mapping, analysis and monitoring; and (b) preparedness – pertaining to local contingency planning, command system, early warning, risk awareness, evacuation drills and simulations and pre-emptive evacuation (at Level 2) and equipping (or provision of technical solutions).

Indirect contribution to Executive Order No. 66, S. 2012, primarily in equipping local chief executives with scientific information to exercise their authority to issue suspension orders (work and classes) in flood prone and high risk areas where PAGASA warning is not available.

Indirect contribution to DILG Memorandum Circular 2012-08 in regard to community disaster preparedness and response. LFEWS particularly contributes to the identification of flood prone areas, early warning, raising Disaster Risk Reduction awareness, conduct of Disaster Risk Reduction drills and evacuation simulations and provision of technical support to local Disaster Risk Reduction and Management Offices.

Indirect contribution to Administrative Order No. 1, S. 2010 pertaining to guidelines in Disaster Risk Reduction integration to subnational development and land use planning. Although the methodological approaches to integration have not been fully developed, LFEWS activities include identification of hazard zones and formulation of disaster preparedness plans that could be integrated into local plans, including land use planning and zoning.

LFEWS Success factors

- The system establishment and maintenance is financially affordable to local governments.
- The watershed approach used by LFEWS directly supports communities in hazard zones that are not yet subject to zoning ordinances or are not covered by relocation plans. It has also been used as input to inform or recommend strategic disaster risk management measures in a city / municipality's land use plan and relocation activities.
- The three-color code of LFEWS flood warning and alert levels are easily remembered and understood by affected communities to enable them to take the corresponding actions towards preparedness and safety.
- Multi-stakeholder cooperation in LFEWS establishment, operations and maintenance is empowering and mutually reinforcing.
- The localization of risk knowledge, early warning and decision-making are the essential features and contribution of LFEWS to disaster preparedness and response.
- The LFEWS Operation Center serves as the most functional steering structure of the system. This structure could serve its purpose before or after the formal structuring of the Disaster Risk Reduction and Management Office.
- LFEWS telemetering demonstrates the value of technological innovation that enables 24/7 availability of hazard data that can be read, understood and gathered by community-based volunteers.

LFEWS Lessons learned

- The sustainability of an Operation Center depends on the institutionalization and strengthening of the Disaster Risk Reduction Management Councils and Disaster Risk Reduction and Management Offices from where the Operation Center derives its authority and resources.

- The convergence of local knowledge for disaster preparedness and response, the political and technical readiness of local governments and communities to adopt new technologies and the availability of new technology and technical skills provide a favorable environment for enhancing the effectiveness of LFEWS. While some components and preparatory activities may require external expertise, local governments and communities could easily operate and maintain LFEWS on their own.

- The ecological criterion for utilizing LFEWS needs to be addressed in the strategic realm, particularly in spatial integration to land use planning. Otherwise, the recurrence of disasters in danger zones – if left unchanged in land use plans – will put stress on the ability of LFEWS to save lives and properties.

ANNEXES

Other Key Costs in LFEWS Establishment

Table 1. IEC and Research Costs

Cost Items	Unit Cost (in PHP)	Unit	Remarks
Participatory Disaster Risk Assessment (PDRA)	10,000	Barangay	Depending on size of watershed and number of vulnerable barangays
Awareness Raising (orientation seminars, forums, inter-personal group-based exercises)	100,000	1 watershed	
IEC Materials (maps, posters, signage, billboards, flyers)	150,000	1 watershed	

Source: GIZ-ENRD, DRM Component

Table 2. Capacity Building Costs

Cost Items	Unit Cost (in PHP)	Unit	Remarks
Training of Observers	600	Per capita, per day x 3 days	Depending on number of Observers
Community Drills	300	Per capita, per day x 3 days	Depending on number of participants; usually around 30-50 persons
Technical Training (troubleshooting) for Observers	800	Per capita, per day x 2 days	Depending on number of Observers

Source: GIZ-ENRD, DRM Component

Table 3. Operations and Maintenance Costs

Cost Items	Unit Cost	Units	Remarks
Salary of OPCEN Core Staff	Based on LGU salary grade	1 per OPCEN	
Salary of OPCEN Support Staff	Based on LGU salary grade	3 per OPCEN	
Incentives for Volunteer Observers	Based on agreed incentives	1 per rain or water level gauge	Depending on agreed incentives
Observers' Equipment (flashlight, writing materials, handheld radios)	3,000	1 x number of Observers	Depending on number of volunteer Observers
OPCEN Office Supplies	5,000	Per Month	
Utilities	10,000	Per Month	
Equipment maintenance (calibration, recalibration, minor repairs)	2-5% of equipment cost	Per Year	

Source: GIZ-ENRD, DRM Component

Table 4. Financial Viability of LFEWS, Binahaan Watershed, Leyte

Political Unit	IRA 2011 (in PHP)	Estimated Amount of Calamity Fund (5% of IRA) (in PHP)	Estimated Proportion of Calamity Fund for Disaster Preparedness (70% of Calamity Fund) (in PHP)	Estimated Cost of a Small Size LFEWS (in PHP)
Province of Leyte	1.1 Billion	55 Million	38.5 Million	
Municipality of Palo	85.5 Million	4.2 Million	2.94 Million	
Municipality of Tanauan	65.4 Million	3.2 Million	2.3 Million	
Total	**2.6 Billion**	**62.4 Million**	**43.7 Million**	**1 Million**

Sources: 2011 IRA Figures - DILG-LGPMS; LFEWS Cost – GIZ-ENRD, DRM Component

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

2B PDCP Bank Center, V.A. Rufino corner L.P. Leviste Sts.
Salcedo Village, Makati City, Philippines

Contact
Dr. Walter Salzer
Program Director and Principal Advisor
Environment and Rural Development Program

Tel. +63 2 892 9051
Fax +62 2 892 3374
Email: walter.salzer@giz.de

www.enrdph.org