Linking Science and the Community for Effective Flood Management

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1. Introduction

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is a technical and scientific institution that has existed for more than half a century. The Agency is at the forefront of issuing early warnings occasioned by typhoons and the attendant flooding, among others. Since 1973, the agency has implemented projects to improve its monitoring facilities to enhance the accuracy and timeliness of its flood forecasts and warnings for the benefit of the communities at risk. Network of fully automatic/telemetered flood early warning systems have been established in at least 4 major river basins and reservoirs in the island of Luzon. However, with the increasing incidence of flooding in urban downstream areas and flash flooding in the upper reaches of small and medium sized catchments in the 1990s, the PAGASA has evolved and enhance its flood forecasting and warning services by taking into account the participation of the community.

Before the turn of the 21st century or on the last year of the International Decade of Natural Disaster Reduction (IDNDR), the community based approach of early warning system evolved as a result of the discussion during a workshop involving disaster managers in the island Mindanao. It was in the said workshop where the indigenous technical knowledge (ITK) of the community in coping with the flood hazard was highlighted. Since then, the PAGASA developed the scheme that will serve as a blueprint for the establishment of a community based flood early warning system (CBFEWS) in the country. The CBFEWS is a cheap, non-structural flood mitigating measure that integrates the basic ingredients of the science of early warning system and the role of the disaster operation center which are basically managed by the local government units (LGUs) and the response of the community.

2. The CBFEWS

The Philippines has already implemented quite a number of flood early warning systems (FEWS) that are managed by the community since 1999. The earlier FEWS established were demand driven. The communities or LGUs in the flood prone areas allocate budget for the activity and request the technical assistance of PAGASA. Among the areas where CBFEWS were installed are: Dumangas, Iloilo, Bulacan and Quezon City. However, after the occurrence of the tsunami in the Indian Ocean in December 2004, early warning system (EWS) took center stage and considered as an important component in total disaster risk management. Foreign donors shifted their resources to EWS to include tsunami and other frequently occurring hydro-meteorological hazards such floods that resulted in the proliferation of initiatives on EWS by non-government organizations (NGOs), government institutions, private sectors, etc.

By the first quarter of CY 2006, the most comprehensive multi-hazards mapping and assessment for effective community based disaster risk management project (Ready project) was launched in the Philippines by the United Nations Development Programme (UNDP) with funding from the Australia Agency for International Development (AusAID). The so-called Ready project is an offshoot of the flashfloods that occurred in December 2004 in the provinces of Infanta and Quezon. It will cover 27 among the 81 provinces in the country for the mapping of geological and hydro-meteorological hazards and 13 provinces for the establishment of CBFEWS within a period of 5 years (2006 – 2011). The criteria in the prioritization of project areas were based on the frequency of disaster occurrence and the economic activity within the area.

2.1 Benefits of a CBFEWS

The immediate benefit of a FEWS is the reduction in the loss of human lives and mitigation of damage to properties. Consequently, the database from the hydrometeorological network will be utilized to derive the local climate of the area for planning and decision making in various sectors such as agriculture, water resources, infrastructure, etc. The immediate benefits of the CBFEWS were highlighted during the recent occurrence of typhoons. In August 2004, Typhoon Marce brought heavy rains in the province of Bulacan that resulted in the swelling of the Angat river and its tributaries. But with the data observed from the FEWS coupled with the storm

warnings, the people in the province were able to harvest their aquaculture products before the fishponds were flooded. The passage of Typhoon Fengshen (locally known as typhoon Frank) in June 2008 caused the worst flooding that devastated the province Iloilo and Iloilo City. Several people died and damage to infrastructure and agriculture was estimated to be more than one billion pesos. However, in the municipality of Dumangas, Iloilo where a CBFEWS is in place, there was no casualty and the emergency team assisted the neighboring towns in rescue operations.

2.2 Design of a CBFEWS

The design of a flood early warning system is dependent on the operative capacity of the LGUs who will manage the system. Each FEWS is unique in itself because of the diversity in cultures, priorities and attitudes of the LGUs and the community where these systems are established. For instance, communities who have experienced a major flood disaster are more receptive and overwhelmed with the operation of a flood EWS compared to those who are exposed to regular but frequently occurring floods. In terms of priorities, more affluent communities put more emphasis on flood control structures as ultimate solutions in mitigating the impacts of flooding rather than investing in FEWS. This may be due in part to the lack of appreciation in the tangible benefits of the system.

From the scientific point of view, such early warning system may be applicable to small and medium sized catchments and where there is enough lead time for the flood prone communities to respond to the warnings. It may employ an automatic system (in terms of data observation and transmission) but the interpretation of observed data and the formulation and dissemination of flood warnings are undertaken by the LGUs in the Disaster Operation Center (DOC). In some areas, purely manual system is established where fabricated rainfall and water level gauges are installed and the community will carry out the observation, recording and transmission of the observed data to the DOC for analyses so that appropriate warnings may be issued. Not only is the basin delineation considered but also the political subdivision as well, for ease in coordination and facilitation of activities.

2.3 Strategies in the establishment of a CBFEWS

Most often the LGUs assume that the installation of flood monitoring devices in their area will equip them with an early warning device without considering the effect

of the upstream condition. However, with the intervention of PAGASA, the LGUs were made to understand the importance of lead times in any early warning system. Hence, the strategy of river or catchment/watershed approach was introduced and adopted in CBFEWS.

The first strategy in the establishment of a FEWS is the consideration of the basin or catchment in designing the network of observation equipment. Given the geographic setting and physiographic features of the watershed, the LGUs and communities should view the EWS in the context of a river basin approach where upstream, midstream and downstream activities affect the time of concentration and the volume of runoff as reflected in the shape of the hydrograph. Given the fact that most flood prone communities are aware that heavy rainfall intensities upstream may result to flooding in the downstream area, the FEWS will systematize or enhance the existing coping mechanisms of communities.

Second, the FEWS must be managed by the community. The residents near the rivers or in flood prone areas are the best people who can cope with the flood hazard because they are equipped with indigenous technical knowledge (ITK) on the behavior of the rivers. The enhancement of the ITK of the community in coping with flooding in their respective area through FEWS and their participation in the operation and maintenance of the monitoring equipment will inculcate in them a sense of ownership. This is one of the issues crucial in the sustainability of the FEWS.

The third strategy is the mainstreaming of the FEWS in the disaster contingency plan of the community in order to ensure the sustainability of the FEWS. Through this scheme, the budgetary requirement for the O&M activities are programmed and sourced out from the 5% calamity fund allocation in every LGU. Although the process will require approval of the municipal/city council through a resolution, such scheme is underscored during consultation meetings and stipulated in the Memorandum of Agreement between the PAGASA and the LGUs which is usually signed before the implementation of the project.

2.4 Activities in the implementation of the CBFEWS

During the 60's, development was generally of a topdown approach. The developed countries who provided funding for development projects believed that they have all the solutions to the problems of the developing countries. Rapid rural appraisals were employed to get information in the rural areas as bases to analyze the

data and formulate project proposals without consultation with the community. Most of the projects failed and the donors realized that development was not easy. As a result of this, the bottom up approach was introduced where consultations were made at the community level before project implementation. Based on the premise that the community must be involved from the inception until the completion of the project, the FEWS will be implemented in two phases, namely, the Preparatory Phase and the Operational Phase.

Since FEWS is usually mentioned in the information drives of the PAGASA and most often recommended for small and medium size rivers, it has gained so much popularity among NGOs and the LGUs. As more experiences and lessons are learned in dealing with the LGUs, the approach of implementing the system is regularly improved to suit the requirement of the beneficiaries. Although there are general guidelines for setting-up a flood early warning system (Hernando, December 2008), the activities of a CBFEWS adopted under the Ready project are described in the subsequent discussions.

The following activities are undertaken in the preparatory or implementation phase of the CBFEWS under the UNDP Ready Project:

a) Consultation with the LGUs to present the proposed project
b) Network design and ocular inspection of the proposed monitoring sites
c) Signing of Memorandum of Agreement (MOA) among stakeholders
d) Fabrication and/or procurement of monitoring facilities
e) Installation of flood monitoring (rainfall and water level gauges, flood markers) and warning facilities (flood signages and bells)
f) Hydrographic survey (cross-sectioning of rivers and flow measurement) to derive the initial assessment water levels
g) On-site training of observers and LGUs on the observation, recording and transmission of data as well as the operation of the FEWS
h) Re-training, special information, education and communication (IEC) and dry run/flood drill
i) Turn over of the FEWS to the LGUs

In the re-training, observers and LGUs are made to present their experiences to check whether they have gained the appropriate skill in data observation, recording and transmission. Flood drill/dry run and IEC are undertaken in a pilot barangay so that the other LGUs will be able to replicate the exercise in their respective municipality.

Thresholds for warning are derived based on rainfall intensities and assessment water levels. The initial values for rainfall intensities were based on previous studies on rainfall induced landslide events in the Philippines. The threshold values are arbitrary and modified when sufficient rainfall and water level data become available. The threshold levels and the corresponding meaning and anticipated response of the community to the warnings are shown in the table below:

Level of Warning	**Rainfall intensity**	**Assessment Water Level**	**Meaning**	**Warning**
Level 1	Value for each level is based on previous studies	River at a particular reference point is about **40% full**.	**Awareness** - that flooding is possible within the next 24 hours.	Ready
Level 2		River at a particular reference point is about **60% full**.	**Preparedness** - that flooding is threatening within the next 12 hours.	Get Set
Level 3		River at a particular reference point is about **100% full**.	**Response** - that flooding is expected to occur / or will persist within the next 12 hours.	Go

The Ready, Get Set and Go warnings for floods has gained popularity and acceptability by the LGUs and the community due to the simplicity and familiarity of the terms adopted. For dissemination of warnings and advisories, the use of fabricated bells is effective especially in remote areas where the signals from telecommunication networks are weak.

In the Operational Phase, the LGUs operate and manage the FEWS by carrying out the following activities.

- Observation and recording of rainfall and water level data at specified time interval described in the DATA OBSERVATION PROTOCOL.
- Analysis of observed data &/or preparation and issuance of flood advisories/ warnings during inclement weather conditions described in the WARNING PROTOCOL.

- Physical check, maintenance & repair, if necessary, of installed instruments & communication system by the observers and LGUs. The local PAGASA will conduct calibration of instruments (raingauges) at least once a year.
- Post flood survey and evaluation of flood warning activities; and
- Documentation of flood warning activities as reference to improve subsequent operation of the CBFEWS.

With the technical assistance of PAGASA, it is envisioned that the LGUs will be able to derive flood indices or establish the correlation between rainfall intensity and the resulting height and extent of inundation in their area.

3. Current challenges encountered in the Ready Project

Implementing a science-based project for the benefit of the community and designed to be operated by the community is a most challenging but satisfying feat since the very existence of science is intended to improve human welfare. These challenges are reflected in issues and concerns derived from the implementation of the FEWS in different project sites, namely:

3.1 Operation and maintenance of the system

The O&M of the FEWS is the responsibility of the LGUs, particularly those who are in charge of the Disaster Operation Center and headed by the Deputized Civil Defense Coordinator (DCDC). The DCDC is normally appointed by the local chief executive of the Municipal Mayor. The DCDC may be the Municipal Agriculturist, Municipal Planning and Development Officer, the Chief of Police or the Social Welfare and Development Officer. The operation and maintenance of the FEWS requires budget and even if the local government law allows the LGUs to spend 5% of their internal revenue allotment for disaster activities, some LGUs find difficulty of ensuring budget for O&M, especially for pre-disaster activities. Although the local government code was relaxed to include pre-disaster activities, majority of the LGUs are still trying to learn the process of accessing funds for O&M activities.

3.2 Fast turn over of local officials

Every 3 to 4 years, local chief executives and members of the municipal council, the law making body in a municipality, are elected by the people. Most often designated officials by the LCEs also change, however if the FEWS is mainstreamed in the local municipal code through the promulgation of an ordinance then sustainability

of the system can be assured. Another issue would be: is the FEWS a priority of the newly elected officials? Most often there are just a number of local government positions that enjoy security of tenure, hence the new LCE has the prerogative to bring in his team of personnel. As a result, the new LCE and personnel or officials need to be trained and most of all appreciate the benefits of the FEWS.

3.3 Sustainability of the FEWS

According to the local government code, each barangay, municipality/city and province must establish a Disaster Coordinating Council (DCC). Each DCC is composed of several committees with special tasks to plan and act before, during and after a disaster. The functions of the committees are stipulated in a Disaster Management Manual or a Disaster Contingency Plan. Since the DCC is an inherent component of any political body in the Philippines, the O&M of the FEWS is anchored on the established DCC. However, in some project areas, the DCCs are organized but inactive or not functional. As a result, the Ready Team assists the LGUs in organizing the DCCs and the formulation of a Disaster Contingency Plan through the conduct of trainings/workshops.

4. The future of FEWS

The prospect of replicating the FEWS in other areas outside the Ready project is high due to its low cost, simple strategy and ease in operating the system since the system has been designed as an enhancement of the community's existing coping mechanism in the eventuality of a flood. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change predicts that occurrence of extreme climate events will be more frequent as a result of global warming. For instance, rain appears to be falling in shorter but heavier intensities resulting to flooding of higher magnitudes. In anticipation of the impacts of climate change, early warning system has been identified as an adaptation measure to the increasing frequency of extreme events, hence the adoption of EWS on flood as a mitigating measure will be a preferred option due to its practicality and familiarity of the system in the community. Since it is the community who will bear the brunt of nature's extremes, they will always take up the challenge within their own capacities to undertake any measure to protect themselves against hydro-meteorological hazards. In addition, the FEWS is a doable and easy to manage scheme.

As more LGUs adopt FEWS in their communities, more lessons are learned and the PAGASA is working on documenting the best practices of the LGUs in operating and sustaining the system. To increase the effectiveness and upscale the FEWS, strategies will continuously being modified to suit the needs of the LGUs and the community. Recently, a city council initiated the establishment of CBFEWS through the enactment of local resolution by the city council even before the implementation of the project. This is the best way to start the FEWS where the LGUs do the planning based on their needs and provide the budget while the PAGASA will guide or facilitate in the establishment of FEWS. Another strategy to stir the interest of the LGUs is to conduct public information drives on FEWS to communities in flood prone areas.

5. Conclusion

The increasing frequency of flooding in rural and urban areas in the Philippines and the anticipated impacts of climate change has transformed the mindset of the communities and the local officials in their preparedness and mitigation efforts. People are becoming more appreciative of the benefits of early warning system as a non-structural flood mitigating measure and this has posed a big challenge for the PAGASA. The request for technical assistance in the establishment of a CBFEWS from NGOs and LGUs both in rural and urban areas has increased to the point that PAGASA need to re-train more technical personnel.

In the formulation of Flood Mitigation Plans for selected river basins in the Philippines (JICA, March 2008), countermeasures for flood mitigation both consider the structural and non-structural approaches. Among the conceivable non-structural approaches, the CBFEWS being promoted by PAGASA was recommended as the applicable measure under the flood mitigation plan.

For PAGASA, the establishment of CBFEWS has extended the coverage of its flood forecasting and warning service, improved its observation network and most of all, enhanced its partnership with the local government units and the community. In due time, the LGUs and the community will realize that meteorology, particularly rainfall forecasting where flood forecasts are based, is not an exact science and that flooding is a result of the interplay between history, nature and society (Bankoff, 2003).

However, the PAGASA advocates that the system be demand driven where the LGUs provide the funding to instill a sense of ownership in the system, an important

aspect to ensure sustainability of the system. The FEWS is a classic example that showcases how science work at the community level

References:

Amadore, L. A., R. P. Encarnacion, M. J. Bautista and S. R. Espinueva. Multi-sectoral Partnership for Sustainable Disaster Prevention, Mitigation and Preparedness: *A Government Agency's Perspective*. Country Report for Philippines presented in the World Water Forum Meeting in Kyoto, Japan, March 2003

Bankoff, G. Vulnerability and Flooding in Metro Manila http://www.iias.nl/iiasn/31/IIASN31_11.pdf

Espinueva, S. R., Establishment of Community Based Flood Early Warning System (CBFEWS) in the Province of Surigao del Sur, UNDP Ready Project, December 2007

Hernando, H. T., Typhoon Committee General Guidelines for Setting-up a Community-based Flood Forecasting and Warning System (CBFFWS), UN ESCAP/WMO, December 2008

Japan International Cooperation Agency, The Study on Flood Risk Assessment and Flood Mitigation Plan for the Selected Areas in the Republic of the Philippines, March 2008

Japan International Cooperation Agency, The Study on Program Formulation in Disaster Mitigation Sector in the Philippines, December 2004

Nilo, P. D., S. R. Espinueva., A.R. Subbiah, L. Bildan and K. Rafisura. Taking up Flooding through a Community-based Early Warning System: http://www.adpc.net/v2007/eLIB/Library-files/CRM/CFA-OFDA-2007-119/CBFEWS_adpc-eLIB=119.pdf

Perez, R. T., S. R. Espinueva and H. T. Hernando, Community-Based Flood Early Warning System. http://www.sea-user.org/download_pubdoc.php?doc=3439