IIRR

Australian AID

Philippines-Australia Community Assistance Program

Community-Managed Flood Early Warning System for Rosario, Cavite

Introduction

The Municipality of Rosario is a first class urban municipality in the province of Cavite, Philippines. According to the 2007 census, it has a population of 94,228 people in an area of 38.16 square kilometers, making it the second most densely populated city/municipality in Cavite after General Mariano Alvarez. Geographically, Rosario is bounded in the north-northeast by Noveleta, in the South by Tanza and in the west-southwest by Manila Bay. It lies 30 km south of Manila, and 17 km south-southwest of Cavite City. It is accessible by land and water (sea) transportation. Rosario is one of the lowland coastal municipalities of Cavite. Due to such location, it is noted for fishing.

The municipality is composed of 20 barangays: Bagbag I, Bagbag II, Kanluran, Ligtong I, Ligtong II, Ligtong III, Ligtong IV, Muzon I, Muzon II, Poblacion, Sapa I, Sapa II, Sapa III, Sapa IV, Silangan I, Silangan II, Tejeros Convention, Wawa I, Wawa II, Wawa III. Located along the coastal flats of the south-western section of Luzon, the municipality exhibits minimal relief with a generally flat topography not exceeding five meters in elevation. The area is characterized by physiographic monotony having slopes limited to the 0-3 percent category. Together with the other municipalities of Noveleta, Kawit and Bacoor, it serves as a catch basin and discharge point of the watershed unit defined by the Tagaytay ridge.

Based from the analysis from the twenty (20) Barangay Disaster Risk Reduction and Management Plans (BDRRMP), the major causes of flooding were due to clogged drainage and inadequate outlet of flood water. Forces of flood include garbage, sand, water, rocks, trunk of trees and other dead domestic animals. Common warning signs observed by the barangays comprised of continuous heavy rain with strong winds, dark clouds, crawling and flying of insects and high-tide. Forewarnings from the hazard were primarily acquired from the PAGASA forecast, television and radio. Upon analysis after the warning signs has been observed, all cluster areas encountered flooding rapidly with approximate time of 30-45 minutes. Annually, the municipality of Rosario experienced flooding twice a year within a period of June to December. The duration of flooding settle within the identified flooded areas for approximately 1 hour to 1 day on average. Lastly, the effects of flooding to the communities can leave devastation of household equipments, sickness, and unavailability for employment, disturbance on water quality for household requirements, increase of garbage, interruption to school activities and disturbance in modes of transportation.

In 2011, IIRR started working in the municipality of Rosario by providing technical assistance and capacity building activities on community-managed disaster risk reduction (CMDRR) in 9 of the 20 barangays. These 9 barangays are the most affected by the hazard of flooding. In 2012, IIRR embarked on a pilot project on community disaster preparedness in 3 most at risk barangays. In this project, IIRR is providing assistance and guidance to the 3 barangays in crafting their contingency plans for the flood and in strengthening their community emergency response teams (CERT) and the regular of drills. An important part of preparedness for flood is the establishment of a community-managed flood early warning system.

IIRR worked with the GIZ-Philippines in designing a local flood early warning system (LFEWS) for the barangays. A workshop on LFEWS was organized together with GIZ. The outcome of that workshop is captured in this document.

Components of a Community-Managed

The terminology "early warning" refers to the information provided to people and communities exposed to an impending danger and that this information is useful in making actions that will save them and their properties when the actual danger comes. Time and quality of information are important elements of a good early warning. The earlier the information is given the more time for people and communities to act in advance and the better the information the more effective will be people's and community's response to the impending danger will be.

Early warning systems (EWS) are an important component of the community-managed disaster risk reduction (CMDRR). The EWS is one of the important systems and procedures to enhance capacities for community readiness and it is embedded in the community's Contingency Plan. The EWS is the trigger that will activate the Contingency Plan during a hazard event. A good EWS will result to a reduction of losses of lives and properties hence reducing the risk of a disaster happening after a hazard event.

The UN-ISDR defines EWS as a set of capacities needed to generate and disseminate timely and meaningful warning information that enables individuals, communities and organizations threatened by hazards to take the necessary preparedness measures and act appropriately in sufficient time to reduce the possibility of harm and losses. Guided by this definition, community-managed EWS according to the ISDR has 4 basic components and these are:

Knowledge of the risks and hazard

The design and contents of the EWS should be based on a sound and accurate assessment of the community risks and the hazard. These are the important characteristics of the hazard that served as the basis for a EWS includes:

- the causes of the hazard,
- warning signs both traditional and formal (scientific and provided by agencies),
- forewarning,
- duration,
- frequency,
- period of occurrence and
- force

This information are made available after the conduct of the participatory disaster risk assessment (PDRA). Other than hazard characteristics, an effective EWS must also be based on a thorough risk assessment whereby the people and the properties that are at risk are identified, they numbers are know and their location are pinpointed. The EWS must target this most risk members of the community.

Based on this information, the EWS system will now identify thresholds, indicators or stages of the development of the hazard and craft different levels of warning information that will be relayed to the most at risk members of the community. For example in a flood early warning system, the level of water in the river might be the basis for creating thresholds or stages. It can also be the amount of rain measured in a rain gauge. If the hazard is drought the basis for staging or thresholds might be the number of months without rain or the number of animals that are dying.

Monitoring and warning procedures

This component of the EWS includes procedures of monitoring the development of hazard on regular basis. The community must be able to assign a permanent monitor that will check regularly the equipment that will check the progress of a hazard such as flood water level markings, rain gauges, etc. The warning procedures include what are the warning levels and the appropriate indicators for each level. For example a common warning procedure in flood is a 3-warning levels of "Ready, Get Set and Go". Ready is level one warning which calls people to be vigilant for a possibility of flood. Get Set is level two warning which calls people to ready their evacuation kits because of flood happening in within 2-3 hours. Finally Go is the final warning which calls people to evacuate already as flood is happening in less than 2 hours. These warning procedures must constantly be updated based on observations of the hazard and forecasting. For example in a flood hazard it is observed that an increase of 1 foot in water level upstream is causes knee-deep flood downstream in a span of 2 hours. This means that people downstream will have 2 hours to prepare once a 1 foot increase in the water level is observed upstream

Dissemination and communication

This component of the EWS is the method of giving the warning to the targeted people and areas of the communities most at risk to the hazard. The tools and mechanisms for disseminating and communication must be well understood by the target audience. The process of consultation and ownership of such tools and mechanisms must rest with the community. Some examples of dissemination and communication approaches in community-managed EWS is the use of community public broadcast system, community bells, use of flags and whistles.

Response capacity

Response capacity in the EWS refers to the actions taken after the different warnings have been disseminated and communicated to the most risk people. These actions are the level of individual, households and communities. The EWS must be clear on what the individual person, the entire household and the community leaders will do whenever the warning is given to them. To increase readiness, community members and leaders especially the most at risk are well informed and educated about these actions or responses to the warning given.

Important principles of CM-EWS are:

Other the 4 important components of the CM-EWS mentioned above, to make the EWS truly community-managed the CMDRR facilitator must ensure that the process of setting up the EWS follows the following principles:

1. The EWS must be based on a genuine process of participatory disaster risk assessment.
2. It must balanced the use of indigenous and scientific knowledge thereby increasing the knowledge of the community on the nature of the hazards.
3. The actual control and management is made by the community; community members are given assignments in the entire EWS components
4. The EWS ensures that internal response capacities are identified and maximized thereby people become more empowered to help themselves.
5. The choice of communication tools and mechanisms must be acceptable and effective at the community level.

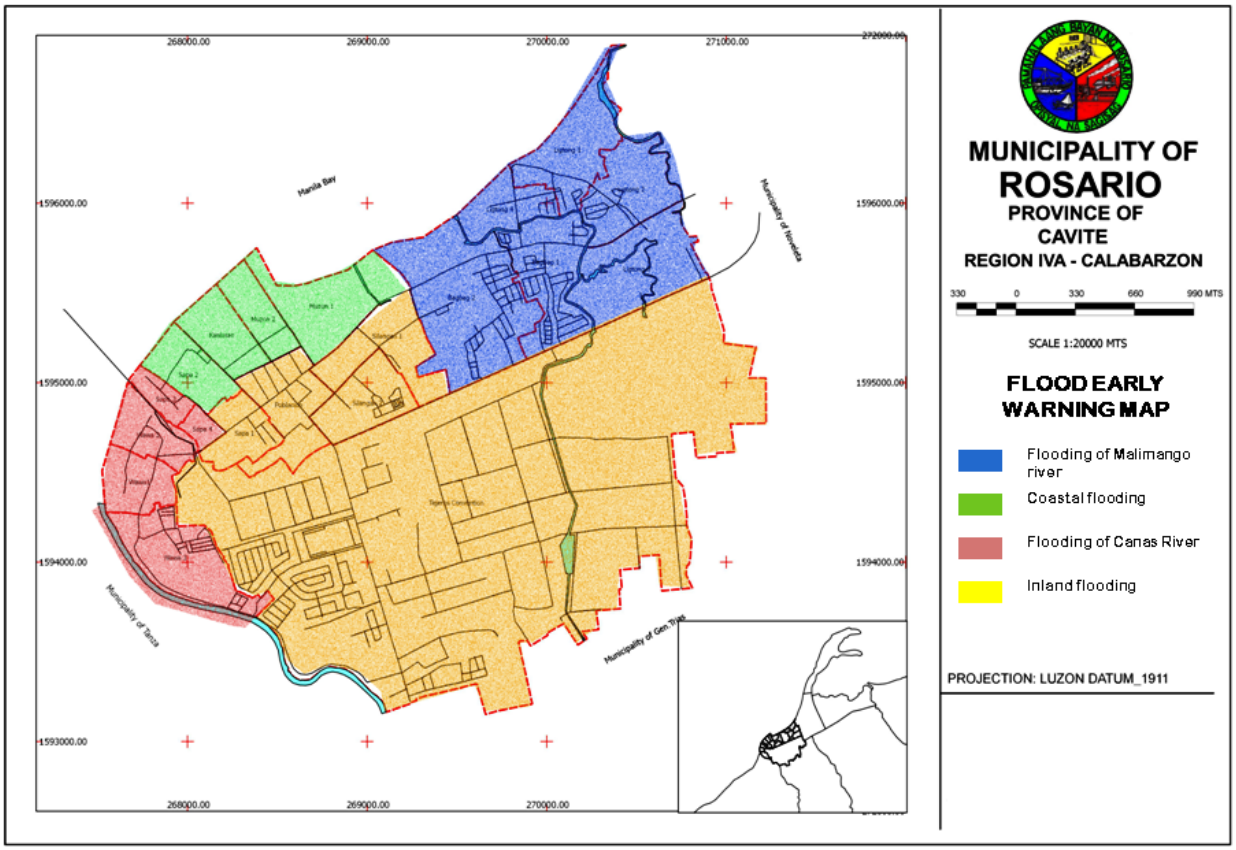
Goal and Objectives of LFEWS

Hazard Analysis: Why is flooding happening in Rosario?

The municipality is drained principally by two major river systems whose headwaters originate from the uplands of Tagaytay City; to the east, traversing the barangays of Tejeros, Ligtong and Bagbag runs the Malimango River whose tributaries empty into the Manila Bay. The larger and meandering Canas River forms the town's south-western boundary with the municipality of Tanza. It is responsible for unloading large amounts of sediments which accounts for the observed shallowing of the port area. This is further enhanced by an active coastal erosions process brought by strong waves and storm surges during the rainy months. The effect of a long shore current and the resulting beach drift phenomenon is the accumulation of depositional features along the municipality's north- western coast.

The extent of flooding of the municipality is a result of the interaction of several factors. First, the dominance of clayey substratum in the soil horizon results to poor permeability and water percolation. This results in excessive surface run-off particularly during monsoonal downpours which are characterized by heavy precipitation. Second, the generally flat terrain and low gradient/slope contribute to slow water movement and localized water impounding. Third, while flooding in the municipality may only be slight and seasonal, this can be exacerbated by tidal movements. The occurrence of torrential rains during high tide can wreak havoc to many barangays.

Based on the analysis, the flooded areas in Rosario can be clustered according to the causes of the flooding. These clusters are shown in the map below:



Cluster 1: Areas located along the Canas River. These barangays are flooded whenever the Canas River overflows and caused by heavy rainfall upstream and downstream and complicated by high tide which reduced drainage rate.

Cluster 2: Areas located at the center of the municipality where flooding is caused by heavy rainfall during high tide. This overwhelmed the drainage canals causing it to overflow to the streets cause knee to waist deep flooding.

Cluster 3: Areas located along the Malimango River. The Malimango river during heavy rainfall also rises and overflows especially if the tides are also high. There are also obstructions and narrow channels long the river which causes flooding in the barangays. The flood waters can rise up to 10-12 feet that happened during TS Milenyo in 2006.

Comprehensive Flood Early Warning System for Rosario

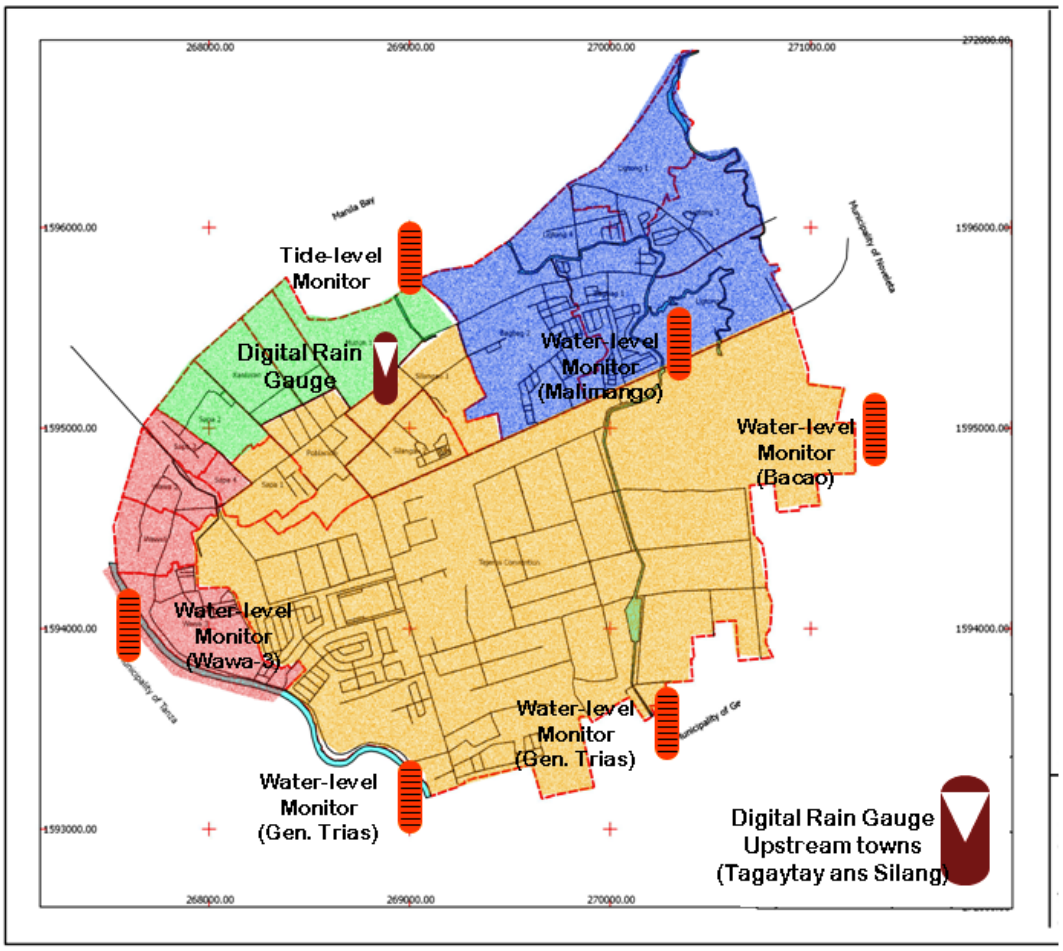
Based on the analysis of the flooding that happens in Rosario, a comprehensive flood early warning system will have 3 components. These components are as follows:

	Barangays included in the cluster	**Equipment and Monitoring Equipment to be installed**
Cluster 1 Along the Canas River	Sapa 3, Sapa 4, Wawa 1, Wawa 2 and Wawa 3	Installation of the following monitoring equipment: ▪ Water-level monitor upstream of Canas River in Gen. Trias town ▪ Water-level monitor in Wawa-3 ▪ Digital Rain Gauge upstream at near the headwaters of Canas River
Cluster 2 Central Rosario (Coastal and Inland Barangays)	Coastal: Sapa 2, Kanluran, Muzon 1, Muzon 2 Inland: Tejeros Convention, Sapa 1, Poblacion, Silangan 1 and Silangan 2	▪ Digital Rain Gauge in Muzon-1 ▪ Tide-Level Monitor in Muzon-1
Cluster 3 Along Malimango River	Bagbag 1, Bagbag 2, Ligtong 1, 2, 3 and 4	▪ Water-level monitor upstream of Malimango River in Gen. Trias or Imus town ▪ Water-level monitor in Bacao River ▪ Water-level monitor in Malimango bridge, Rosario ▪ Digital Rain Gauge upstream at near the headwaters of Malimango River

Setting-up a comprehensive flood early warning in Rosario requires the support of provincial government and the local government units where the monitoring equipment will be installed. The LGU that will host the equipment will ensure the monitoring and maintenance of the equipment as well as ensure that information generated is relayed to the designated operation centers. IIRR proposes that the provincial government through the Cavite Office of Public Safety (COPS), consider as a disaster preparedness initiative that will benefit the low-lying municipalities and cities of Cavite.

Monitoring

Given that the resources available to set-up an early warning system is very limited, IIRR through PACAP will support the flood early warning for Cluster 2. IIRR will establish 1 digital rain gauge and 1 concrete tide monitor in barangay Muzon-1. The information that will be generated from this monitoring equipment will be useful for all the barangays located in the central part of Rosario particularly Cluster 2 barangays. In order to achieve a more comprehensive flood early warning system for Rosario, the map below shows the additional monitoring stations that needed to be installed in addition to the ones installed in Muzon-1.



The digitial rain gauge will monitor the amount of rainfall that Rosario receives in any given time. Alarm will be raised whenever the rainfall reaches 40 millimeters within 4 hours as this is categorized by PAGASA as an abnormal heavy rainfall already. The tide monitor installed along the coastline of Muzon

will inform the barangay whether there is high or low tide. This is important because per analysis, heavy rainfall coupled with a high tide will translate to flooding in Rosario. The barangay LGU of Muzon-1 is tasked to provide personnel who will regularly monitor and maintained the monitoring equipment.

Flood Alert and Warning Levels

Based on the LFEWS workshop conducted, the following is the summary of the Flood Early Warning System that will be operational in the Cluster 2 barangays.

Warning Level	What to watch out for	Communication and Dissemination	Response
Level 1 **Code: Yellow** **"Possibility of flooding may happen"**	Continuous rainfall, severe weather warning from PAGASA (e.g. typhoon, LPA, monsoon rain)	Information is disseminated to the community members through megaphone and house to house alert by the assigned EWS team of the barangays	**Household:** ▪ Be vigilant (Magbantay) ▪ Listen to advise from authorities (Makinig) ▪ Listen to the news (Makibalita) ▪ Gather all members of the households at home **BDRRMC OpCen:** ▪ Monitoring of rain gauge and tide monitor ▪ Cancel classes of Day Care Centers ▪ All emergency response teams (evacuation, first aid, etc) are on high alert status
Level 2 **Code: Orange** **"High possibility of flooding"**	Rain gauge reaches 40 mm within 4 hours	Continuous hitting of the "Batingting" for 1 minute and every 15 minutes	**Households:** ▪ Prepare household emergency kits (food, clothing, sleeping materials, medicines, important documents and eating utensils) ▪ Prepare for possible evacuation to the barangay evacuation center ▪ Elevate important appliances e.g refrigerator, stove, clothing, etc **BDRRMC OpCen:** ▪ Continue monitoring of rain gauge and tide monitor ▪ All emergency response teams (evacuation, first aid, etc) are on high alert status ▪ Evacuation teams deployed to their area of responsibilities to execute evacuation procedures.
Level 3 **Code: Red** **"Flooding is certain, evacuation is required)**	Flooding in the streets rises to 1-2 feet already	Continuous sounding of the barangay manual-operated Siren	**Households:** ▪ Proceed to the evacuation center ▪ Follow the designated evacuation route ▪ Secure members of your household e.g. pregnant, children, elderly and PWDs) ▪ Do not panic. **BDRRMC OpCen:** ▪ Activate the barangay CONTINGENCY PLAN ▪ Convene the BDRRMC for Emergency Response operations ▪ Emergency Teams respond to the evacuees ▪ Evacuation team assist the evacuation ▪ Monitor the people that refused to evacuate

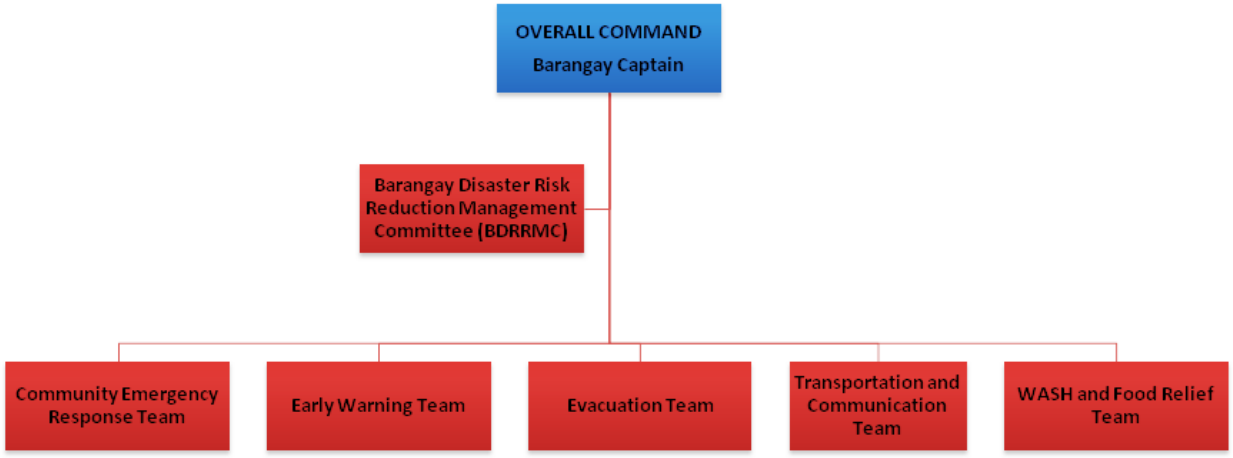
Communication and Coordinating Protocols

Although the monitoring stations for the flood is located in barangay Muzon-1, the information is available for all the barangay LGUs in Rosario. The barangay captain of Muzon-1 acting as the overall coordinator of the Operation Center in Muzon-1 will contact his counterparts in other barangays. All barangays in Rosario have been provided already with transceivers to facilitate the sharing of information. Whenever, Muzon-1 issues a Flooding Warning, they will share this information and regularly update the information. The following table is a schedule of the types of information an frequency of sharing information to identified agencies and officials of Rosario:

Type of Information	Recipients	Frequency of Updates
Status of Flood Warning This is information pertaining to the issuance of flood warning. Once Muzon-1 issues flood warning Level 1, the OpCen will share this information already including upgrading and downgrading of flood warning status.	All 19 barangay captains, MDRRM Officer of Rosario	As soon as the flood warning status changes; either upgrading or downgrading warning status.
Rainfall information This is information generated from the install rain gauge in Muzon-1.	All 19 barangay captains, MDRRM Officer of Rosario	Whenever it rains in Rosario and the rain gauge picked up information, this will be shared to the recipients. Rainfall information will be shared: ▪ Every 30 minutes of Level Warning is activated ▪ Every 15 minutes if Level 2-3 warning are activated
Tide Information This is information whether the tide is rising or not. This is generated from the tide monitor install in Muzon-1	All 19 barangay captains, MDRRM Officer of Rosario	Whenever it rains in Rosario. The tide will also be monitored. The information is shared together with rainfall information: ▪ Every 30 minutes of Level Warning is activated ▪ Every 15 minutes if Level 2-3 warning are activated
Status Report of Response This is information related to the status of Muzon-1 especially the response it is doing if it reaches Level 3 warning. Information generated from OpCen of the barangay particularly the Damage Assessment and Needs Analysis (DANA) will also be shared.	MDRRM officer only	Once Level 3 warning is activated in Muzon-1, the barangay captain will update the MDRRMO of the status of the barangay regarding the evacuation and response. Updating of information is up to the discretion of the barangay captain.

Barangay Response Capacities

The 3 barangays that IIRR and PACAP are assisting have existing community emergency response teams (CERT). This team is trained on first aid, water safety and rescue. Aside from the CERT, each barangay also have formulated their Flood Contingency Plan which laid down the protocols and procedures that the BDRRMC will follow in case Level 3 warning is activated in the barangay. The contingency plan has protocols for evacuation, communication, transportation, food, water and hygiene, emergency response and early warning. Each of these protocols has been assigned with volunteers from the ACDV. The contingency plans of the 3 barangays will be subjected to consultation and community drills and simulation to further enhance the protocols. Below is the command structure of the Barangay response once Level 3 flood warning alarm is raised:



Way Forward

Like any system, its utility and effectiveness is determined by regular testing and updating. To ensure that the system will run like a "well-oiled machine", its components especially the monitoring equipment and personnel have to be maintained and trained. For testing and updating of the protocols laid down in this system, the communities will conduct simulation exercises and community drills in order to identify possible kinks and the necessary changes implemented. It is advisable that the community conduct this simulations and drills prior to the onset of the rainy season starting in May. The people tasked to maintain the equipment as well as tasked to monitor them have to be provided with skills and knowledge. The municipal government is encourage further to invest in the remaining components of the EWS as well as replicate the practices of the 3 pilot barangays in this community-managed flood early warning system.