



PROJECT CLIMATE
Twin Phoenix



Flood Forecasting and Warning System for Cagayan De Oro and Iligan Cities

Project Climate Twin Phoenix

Tropical storm Sendong, which washed out parts of Cagayan De Oro and Iligan cities in 2011, demonstrated how extreme climate events could worsen the impact of flooding on people, property and communities. During Sendong, over a thousand lives were lost, 131,618 families were displaced from their homes, and close to P2 billion of infrastructure, crops and schools were damaged by the floodwaters (NDRRMC).

Project Climate Twin Phoenix, a project implemented by the Climate Change Commission, and with support and technical assistance from the United Nations Development Programme and the Australian government, supports the long-term recovery of the flood-affected areas by improving the governance system within a community. It provides knowledge-based inputs to local governments that will guide its planning and decision making and in advancing policies that will support strategies and actions toward sustainable development in the area.

Central to this approach is the integration of flood risks into local planning by ascertaining the likelihood of flooding and its potential negative consequences. For this purpose, Project Climate Twin Phoenix has generated climate-adjusted flood hazard maps for different rainfall scenarios which will show the extent of the flooded area, the depth of flood waters, and the period of flooding and can give an established calculated lead time for early warning for different rainfall scenarios. Data used for the climate-adjusted flood hazard maps were derived by the project from modeling the four major river basins of Mandulog, Iponan, Cagayan De Oro, and Iligan.

As a tool, the climate-adjusted flood hazard maps are useful for decision makers in the preparation

of their flood contingency plans and for the installation of early warning systems in strategic places, among others.

Project Climate Twin Phoenix has assisted Iligan and Cagayan de Oro in the preparation of their flood contingency plans using the climate-adjusted flood hazard maps as basis for estimates for possible repositioning of goods and services needed for response and early recovery should a flood disaster happen in the future. Iligan approved its contingency plan on March 2014 while Cagayan de Oro is already in the process of getting the approval of the cluster heads prior to the endorsement of the flood contingency plan to its Sanggunian.

The information derived from the formulation of the climate-adjusted flood hazard maps, such as the river profile or depth and velocity of flood waters, is also used in the river management and integrated early warning system program of PAGASA. Project Climate Twin Phoenix provided assistance to PAGASA in procuring and installing the flood forecasting and warning system.

Flood Forecasting and Warning System

Flood Forecasting and Warning System (FFWS) is regarded as a critical tool for saving lives, livelihoods, and property. It provides sufficient lead time for communities to respond. In partnership with PAGASA and the local government units of Cagayan De Oro and Iligan, Project Climate Twin Phoenix seeks to incorporate early warning systems as an integral component of its disaster risk reduction and management strategy. As such, it will establish a telemetered flood forecasting and warning system in the river basins of Cagayan de Oro and Mandulog using data from rainfall and the rivers' water level.

The river-basin-wide monitoring network is expected to improve the governments' and communities' monitoring and response capabilities to be able to plan ahead on how to manage a flood, to give accurate warning to the people, and, ultimately, to save lives and protect property.

The FFWS supports existing hydromet stations installed by PAGASA in both rivers. It sends real-time hydrological data via radio communication to local government authorities. These data are then fed into the SMS-based disaster warning system that is used to send flood information alerts to the public.

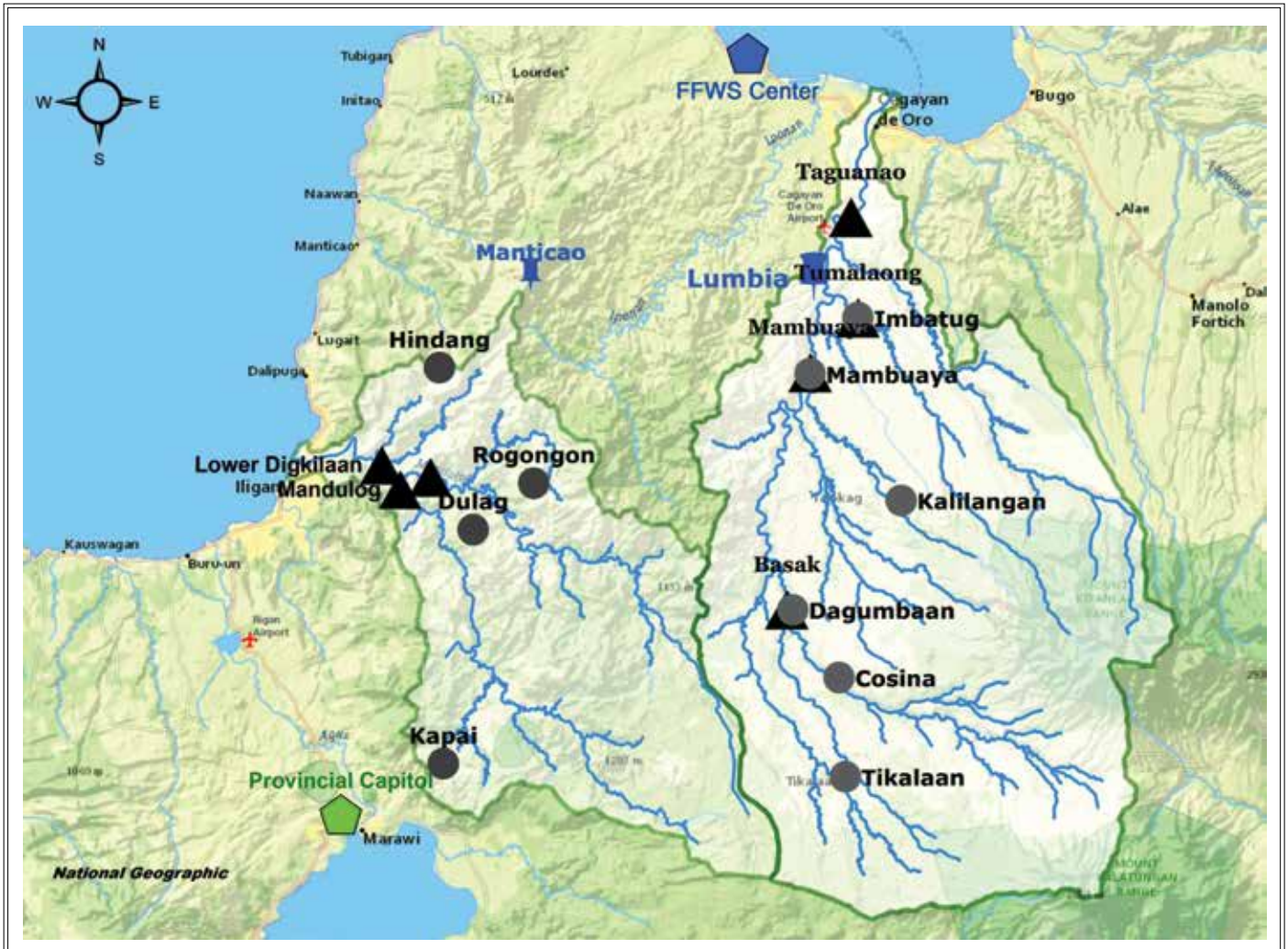


Fig. 1 Flood Early Warning System of Cagayan De Oro and Mandulog River Basins

Key elements of an FFWS:

1. Risk knowledge
2. Monitoring & Warning
3. Information dissemination and communication – Flood Warnings and bulletin
4. Response capability – Flood Drills

Risk Knowledge

Flooding can be managed when communities are knowledgeable about their flood risks and the government's emergency preparedness and mitigation strategies are in place. This knowledge must be based on evidences, which are systematically drawn from risk and

vulnerability assessments, hazard mappings, and climate projections and trends.

To promote informed decision making, a Climate and Disaster Exposure Database (ClimEx.db) has been designed by Project Climate Twin Phoenix as a tool that will help communities and local governments in planning their land use and development while incorporating measures to adapt to the effects of climate change in their localities. ClimEx.db provides geo-referenced data on population, buildings, infrastructure and economic activities in the cities that are considered high-risk for flooding or which are predisposed to the impacts of extreme weather events.

Monitoring and Warning

The monitoring network consists of automatic rain gauges and automatic water level measuring

stations within the watershed or river basin. The rainfall readings and water level heights are automatically measured and transmitted via a digital two-way radio relay network first to the River Basin Flood Forecasting and Warning Center (RBFFWC); then, to the PAGASA Flood Forecasting and Warning Center (Quezon City) and PAGASA Regional Service Divisions (PAGASA-RSD); down to the concerned government agencies (National and Regional offices of DPWH and OCD) and LGUs (Provincial and City DRRMCs). All observed data are stored into a database where it can be analyzed, remotely viewed, and used as inputs for flood forecasting models. The flood forecast derived from the models becomes the basis for providing advanced information when there are threats of river flooding during periods of excessive rainfall in the form of flood bulletins/advisories and warnings.

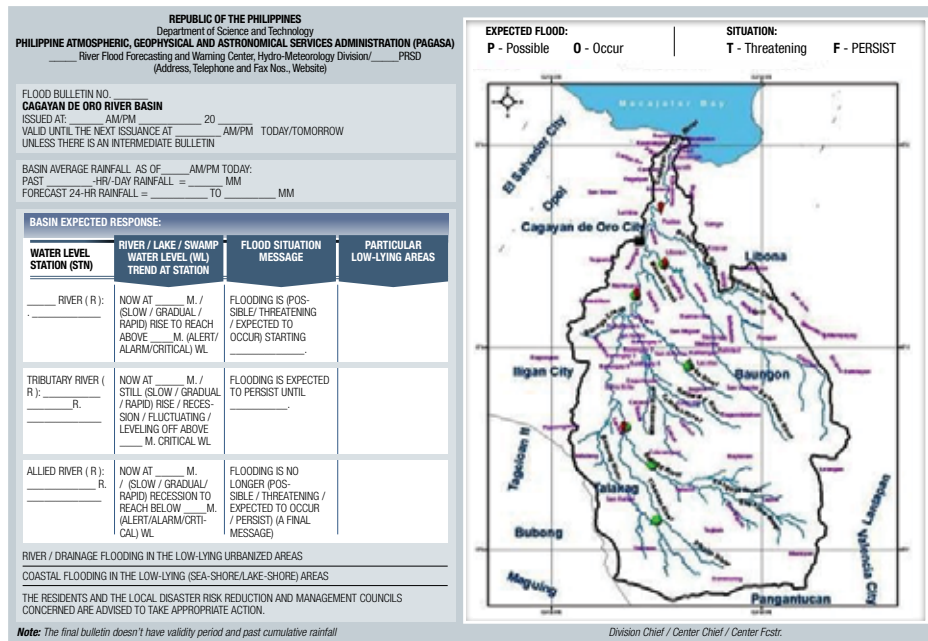


Fig. 2 Flood Bulletin for Cagayan de Oro River Basin

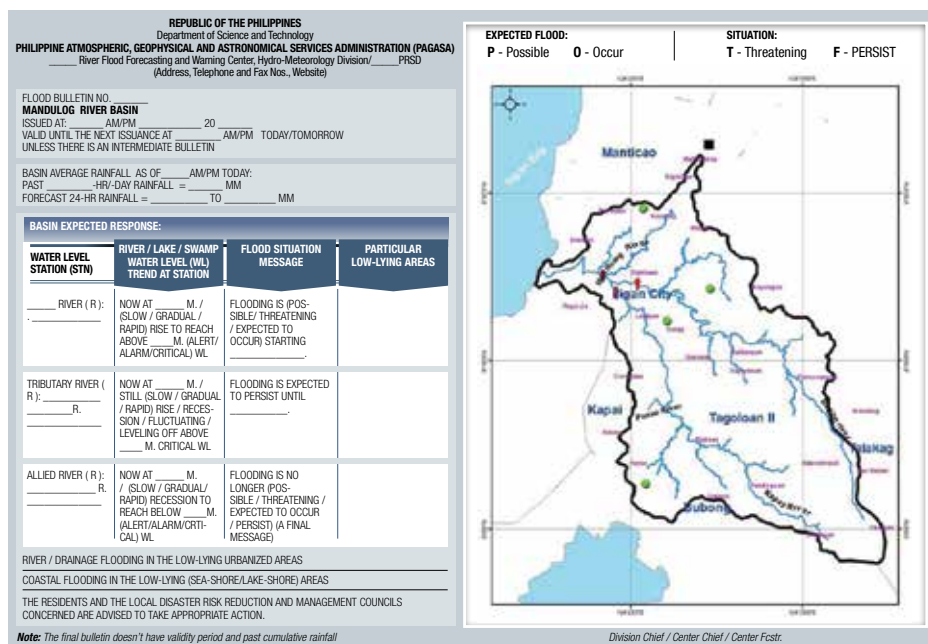


Fig. 3 Flood Bulletin for Mandulog River Basin

Flood Warnings and Bulletin

An efficient flood warning service requires information, knowledge sharing, and effective communication. When an event is imminent or already occurring, an accurate bulletin prepares the people who receive it for the responses required of them at a certain time.

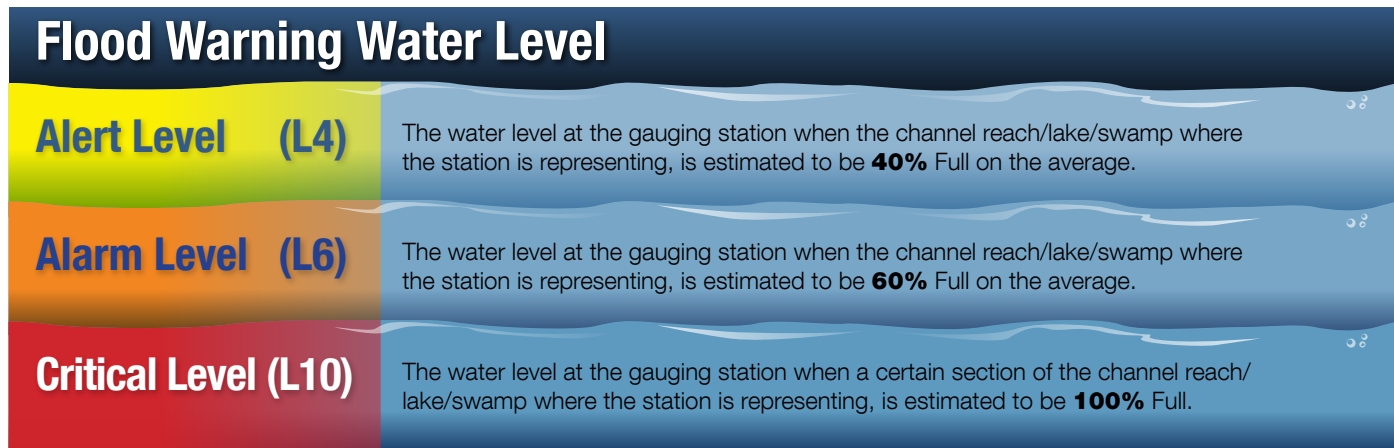


Fig. 4 Flood Warning Water Level

Pre-Water Level Assessment for Cagayan de Oro and Mandulog River Basins

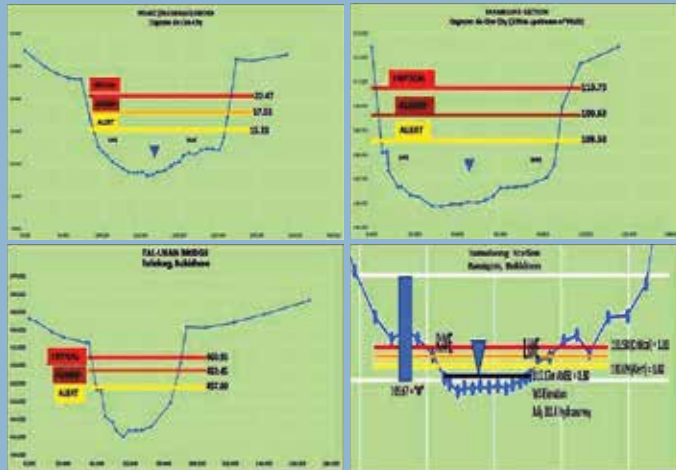


Fig. 5 Pre-water level assessment for Cagayan de Oro River Basin

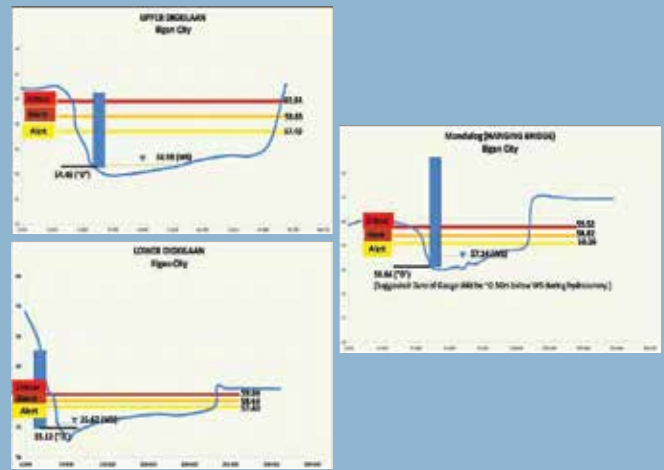


Fig. 6 Pre-water level assessment for Mandulog River Basin

Response Capability: Flood Evacuation Drills

In order to test and evaluate the flood early warning system and the communications protocols and evacuation procedures contained in the flood contingency plan of an LGU, a flood evacuation drill will be conducted. The drill will be participated in by key members involved in disaster risk reduction and management and communities considered high risk for flooding.

During the drill, different scenarios will be simulated and concerned authorities will be expected to implement their contingency plan in terms of establishing a communication and prevention system, monitoring water level, issuing warnings,

transferring affected people, and securing the affected population in designated evacuation centers.

FLOOD WARNING AND EVACUATION DRILL FOR Cagayan de Oro River Basin – Cagayan de Oro City December 9, 2014		
Scenario : Typhoon Pablo Brgy. Macasandig		
PREPARATORY PHASE	RIVER / LAKE / SWAMP WATER LEVEL (WL) TREND AT STATION	FLOOD SITUATION MESSAGE
1. PAGASA FFW Center issue a weather Bulletin in CDORRMO - Iligan	CDORRMO-CDO relay to BDRRMO's Activation Status of DRRMC is ACTIVATED	Fax No. FFW Center (El Salvador) Fax No. CDORRMC
2. FFWs issue a Flood Advisory issued to CDORRMO - Iligan (Significant amount of rainfall observed in Cosina, Talabuan and Imbatug and Kallangan Stations)	Flood Advisory from PAGASA relay to concerned BDRRMO's ... through Hand-held radio, sms Required Actions: • MONITORING STATUS for BDRRMO's • ACTIVITIES along /in the river are Suspended	Fax No. FFW Center (El Salvador) Fax No. CDORRMO
FLOOD WARNING STAGE		
ALERT: FFWS issue a Flood Bulletin No. 1 issued to CDORRMO - Iligan Water level at Tumalaog, Tal-uban, Mambuaya, the ALERT level	YELLOW LEVEL is activated: inform BDRRMO's thru hand-held radio, and/or SMS Required Actions: • Residents are on "READY" status. • Make people aware of the situation by SMS and announcement to local media • Heightened awareness. • Barangays conduct "recorrida." • PNP and BFP assist in conduct of "recorrida."	Fax No. FFW Center (El Salvador) Fax No. CDORRMO
ALARM: FFWS issue a Flood Bulletin No. 2 issued to CDORRMO Water level at Tumalaog, Tal-uban, Mambuaya and TAGUANAO reached the ALERT level	ORANGE LEVEL is activated: BDRRMO's thru hand-held radio, and/or SMS Actions required: • Residents to be on "GET-SET" status. • Vulnerable Sector to be pre-emptively evacuated. • "Recorrida" continues.	Fax No. CDORRMO
CRITICAL: FFWS issue a Flood Bulletin No. 3 issued to CDORRMO - Iligan Water level at Tumalaog, Tal-uban, Mambuaya and Taguanao Stations reached the CRITICAL Level	RED LEVEL is activated: BDRRMO's thru hand-held radio, and/or SMS Actions required • Residents are on "GO" status. • Implement Forced Evacuation. • CDORRMO turn on the WARNING alarm	Fax No. CDORRMO 1.
FFWS issue a FINAL FLOOD BULLETIN issued to CDORRMO (Termination of flood Warning) Water level in all stations are at below the Alert level or Flood is receding	TERMINATION of Flood Warning relay to BDRRMO's for the return of the evacuees	

Fig. 7 Flood Warning and Evacuation Drill for Cagayan de Oro River Basin

Fig. 8 Flood Warning and Evacuation Drill for Mandulog River

FLOOD WARNING AND EVACUATION DRILL FOR Mandulog River Basin – Cagayan de Oro City December 9, 2014		
Scenario : Typhoon Pablo Brgy. Santiago		
PREPARATORY PHASE	RIVER / LAKE / SWAMP WATER LEVEL (WL) TREND AT STATION	FLOOD SITUATION MESSAGE
1. PAGASA FFW Center issue a weather Bulletin in CDORRMO - Iligan	CDORRMO-CDO relay to BDRRMO's Activation Status of DRRMC is ACTIVATED	Fax No. FFW Center (El Salvador) Fax No. CDORRMC
2. FFWs issue a Flood Advisory issued to CDORRMO - Iligan (Significant amount of rainfall observed in Rogongan, Kapal and Hindang RP Stations)	Flood Advisory from PAGASA relay to concerned BDRRMO's ... through Hand-held radio, sms Required Actions: • MONITORING STATUS for BDRRMO's • ACTIVITIES along /in the river are Suspended	Fax No. FFW Center (El Salvador) Fax No. IDORRMO
FLOOD WARNING STAGE		
ALERT: FFWS issue a Flood Bulletin No. 1 issued to CDORRMO - Iligan Water level at Mandulog, Upper Digkilaan, Lower Digkilaan reached the ALERT level	ISSUE: ICDRRMC ADVISORY NO. 2 (Preparedness Status) through FB. No. 1 included in ICDRRMC ADVISORY NO. 2	Fax No. FFW Center (El Salvador) Fax No. IDORRMO
ALARM: FFWS issue a Flood Bulletin No. 2 issued to CDORRMO Water level at Mandulog, Upper Digkilaan, Lower Digkilaan reached the ALARM level	ISSUE: ICDRRMC ADVISORY NO. 5 (Evacuation Status) through FB. No. 2 included in ICDRRMC ADVISORY NO. 5	Fax No. IDORRMO
CRITICAL: FFWS issue a Flood Bulletin No. 3 issued to CDORRMO - Iligan Water level at Mandulog, Upper Digkilaan, Lower Digkilaan reached the CRITICAL Level	ISSUE: ICDRRMC Relay to BDRRMO the FB No. 3 FORCED EVACUATION	Fax No. IDORRMO
FFWS issue a FINAL FLOOD BULLETIN issued to CDORRMO (Termination of flood Warning) Water level in all stations are at below the Alert level or Flood is receding	TERMINATION of Flood Warning relay to BDRRMO's for the return of the evacuees	Fax No. CDORRMO 1.