



行政院農業委員會水土保持局  
Soil and Water Conservation Bureau, COA



## **OGC Asia Forum**

# **3D Spatial Infrastructure for Smart Cities Application**

## **Comprehensive Landslide Hazard Management in Taiwan**

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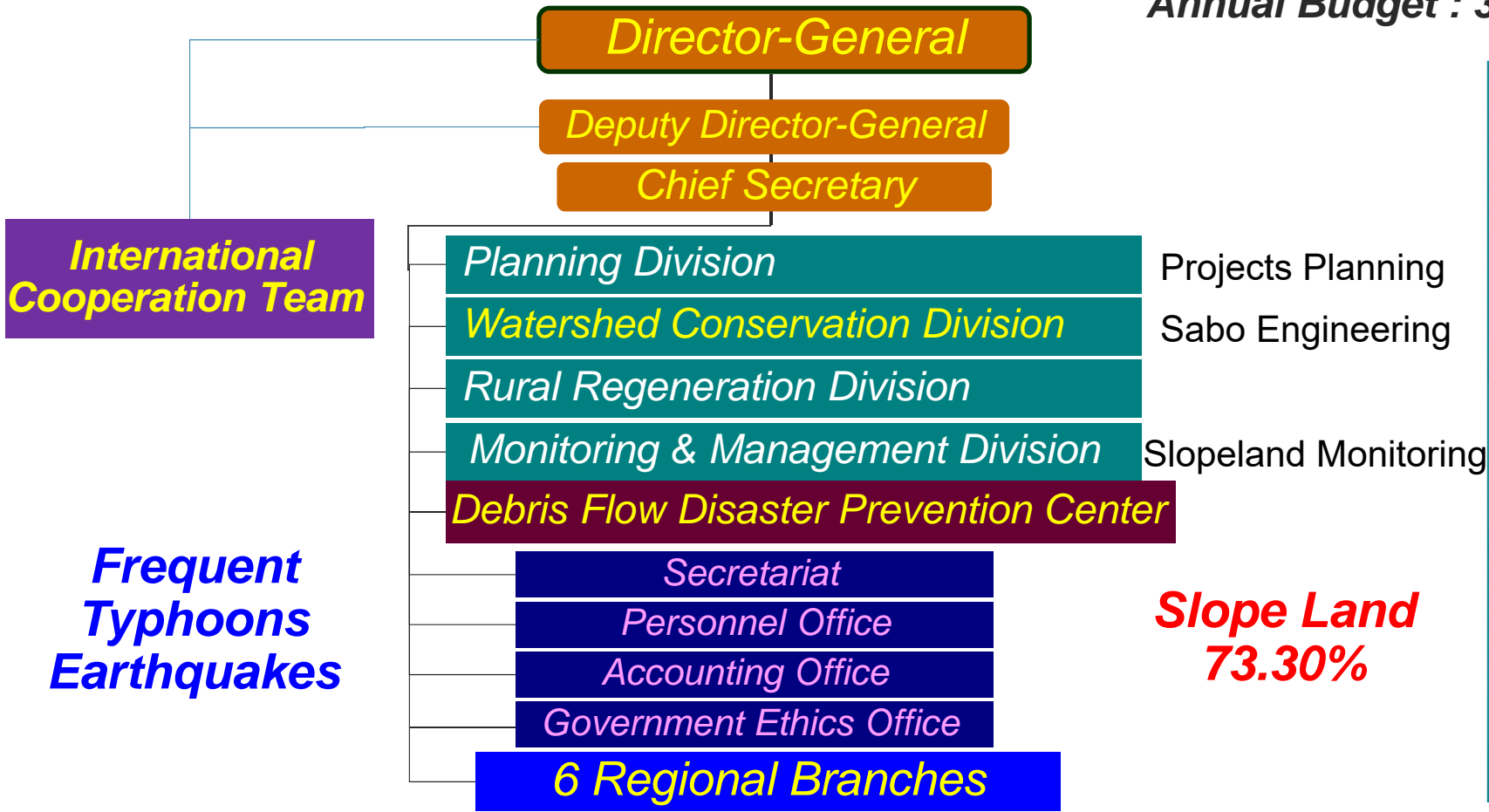
**Soil and Water Conservation Bureau(SWCB), Council of Agriculture, Taiwan**

**17 June, 2021**

# Soil and Water Conservation Bureau

## Organization Chart

Total personnel : 650  
Annual Budget : 300 million USD



**Slope Land  
73.30%**

**Frequent  
Typhoons  
Earthquakes**



# Debris Flow Disasters in Taiwan

1996-Herb



2004-Mindulle

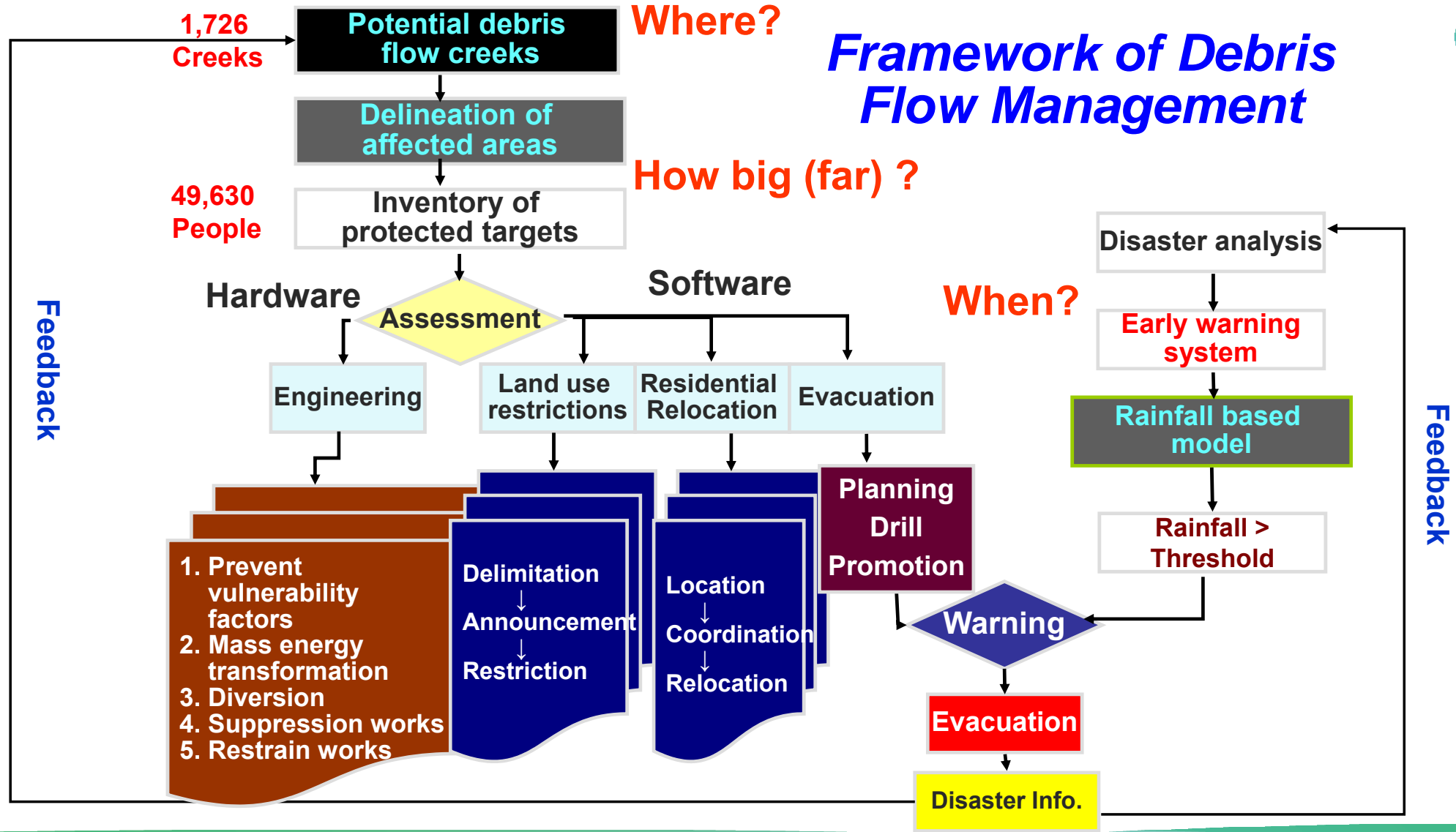


# Framework of Debris Flow Management

Where?

How big (far) ?

When?



Feedback

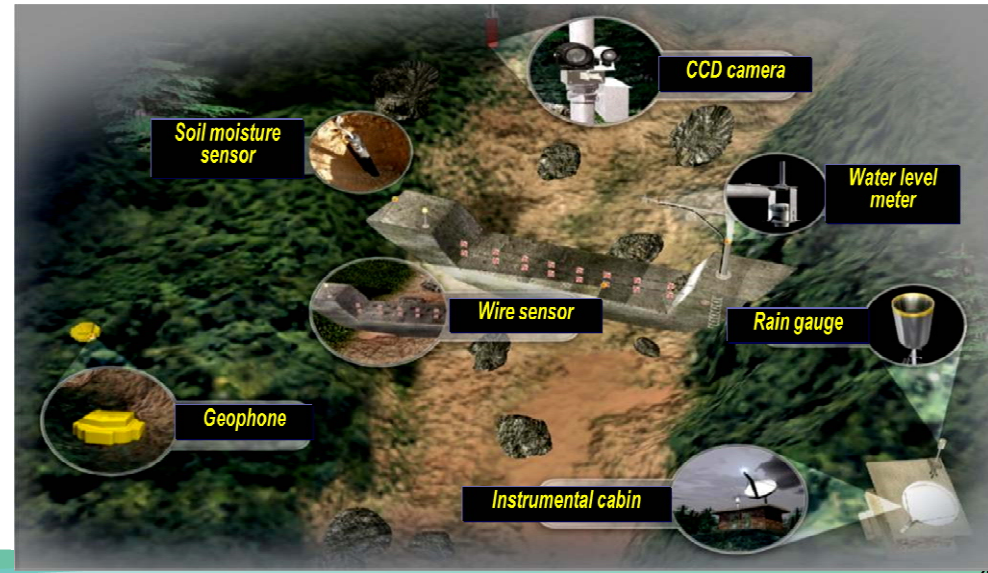
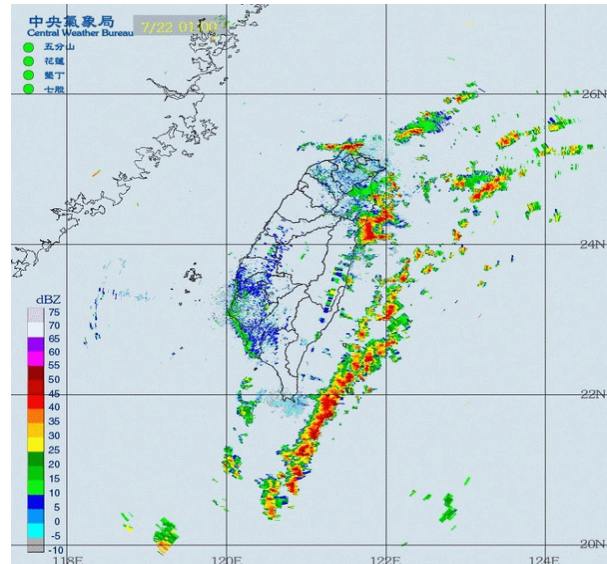
Feedback



# Debris Flow Emergency Operation Task Force of SWCB

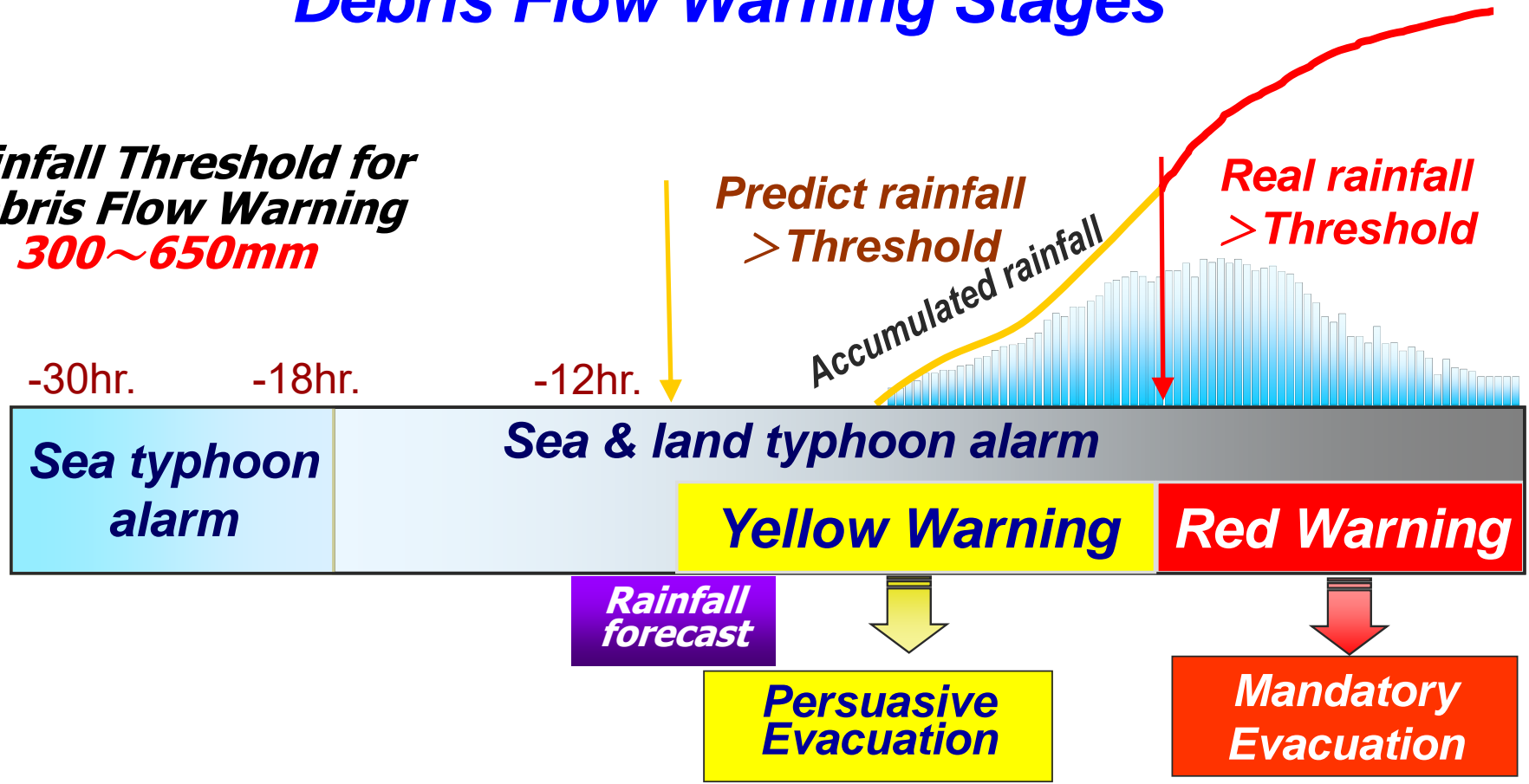


- *Web-based Decision Support System*  
<http://fema.swcb.gov.tw>
  - *Real-time Rainfall Data Sources (10 min)*
    - 507 auto-rain-gauges*
    - 40 on-site monitoring stations*
    - 550 disaster resistant communities*
- QPESUMS Radar System**  
Quantitative Precipitation Forecast (QPF)  
NOAA, CWB, WRA **1.3X1.3Km**
- *Debris flow warning announcement*



# Debris Flow Warning Stages

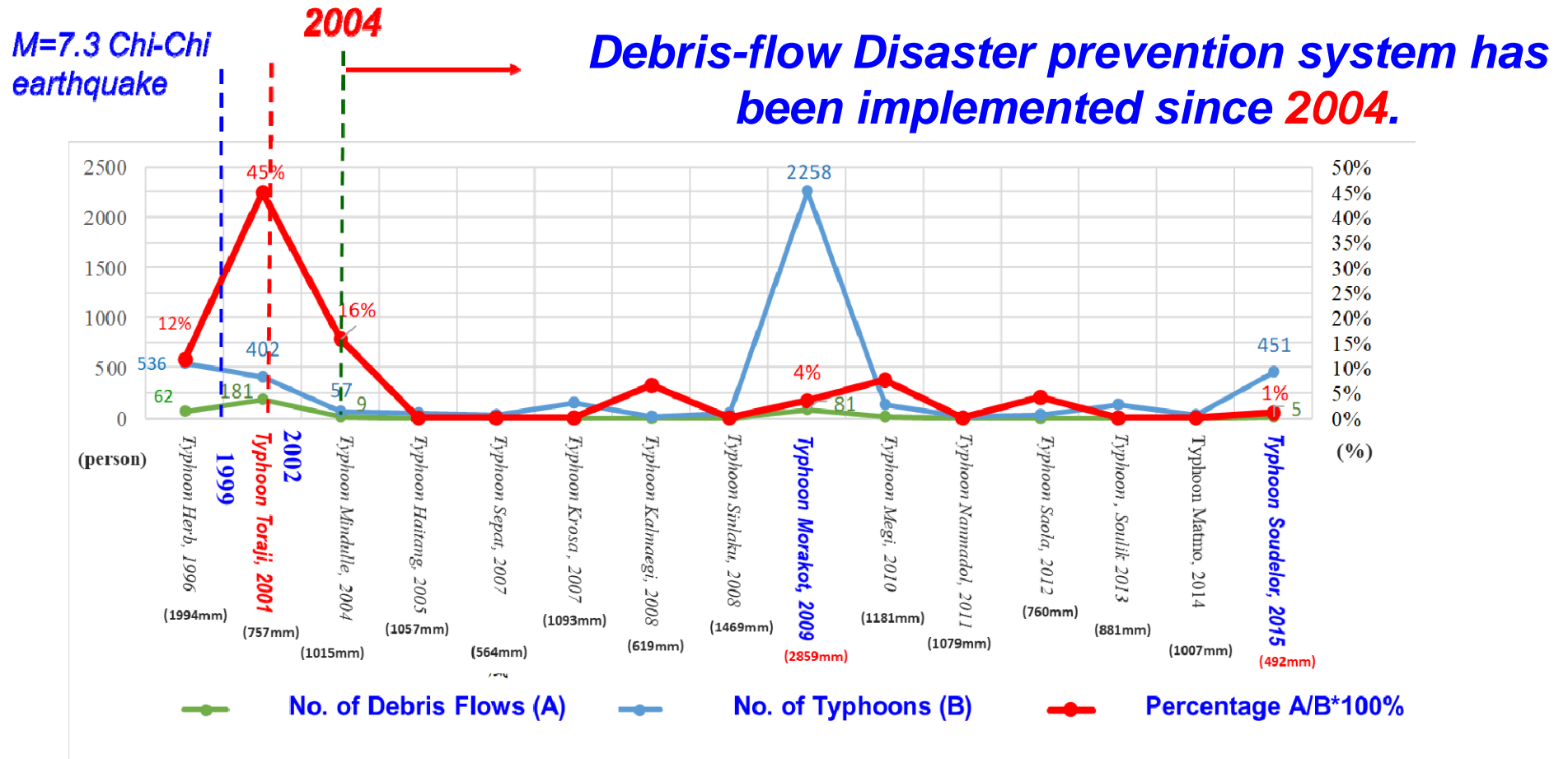
■ **Rainfall Threshold for Debris Flow Warning**  
**300~650mm**



Local government should **Advise** the inhabitants to evacuate.

Local government should **Force** the inhabitants to evacuate.

# No. of Casualties and Wounded Debris Flows vs Typhoon





# Deep-Seated Landslide in Hsiaolin Village During Typhoon Morakot, 2009



Landslide occurred at am 6:16, Aug 9, with **R=1676.5 mm**  
Average slope: 22 degrees; Landslide area: 202 ha;  
Depth: **82 meters** ; Volume: **25 million m<sup>3</sup>**  
Dead and missing: **457 casualties**

Formosat-2





## Comprehensive Program of Large-scale Landslide Hazard Mitigation under Climate Change Impact

**Definition: Area 10 ha; Depth 10 meters ; Volume 100,000 m<sup>3</sup>**

**1st Stage : 2017-2020(4 years), Budget : 110 million USD --34 sites**

**2nd Stage : 2021-2026(6 years), Budget : 180 million USD --64 sites**

Before



After

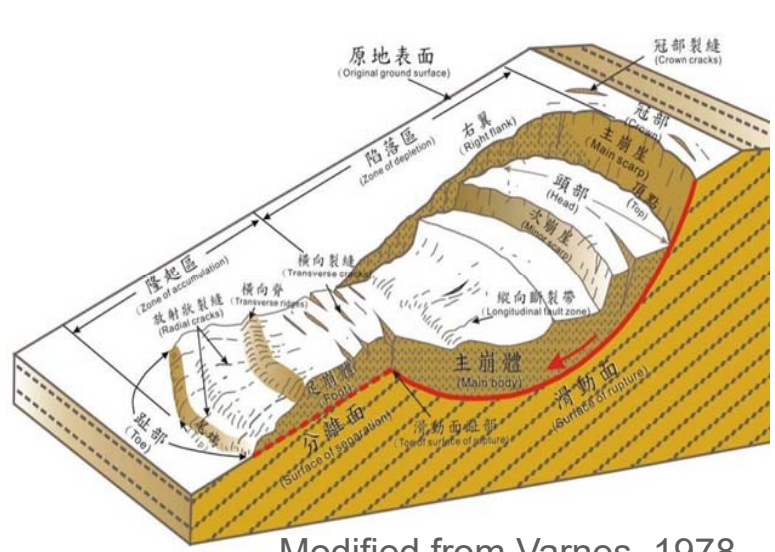
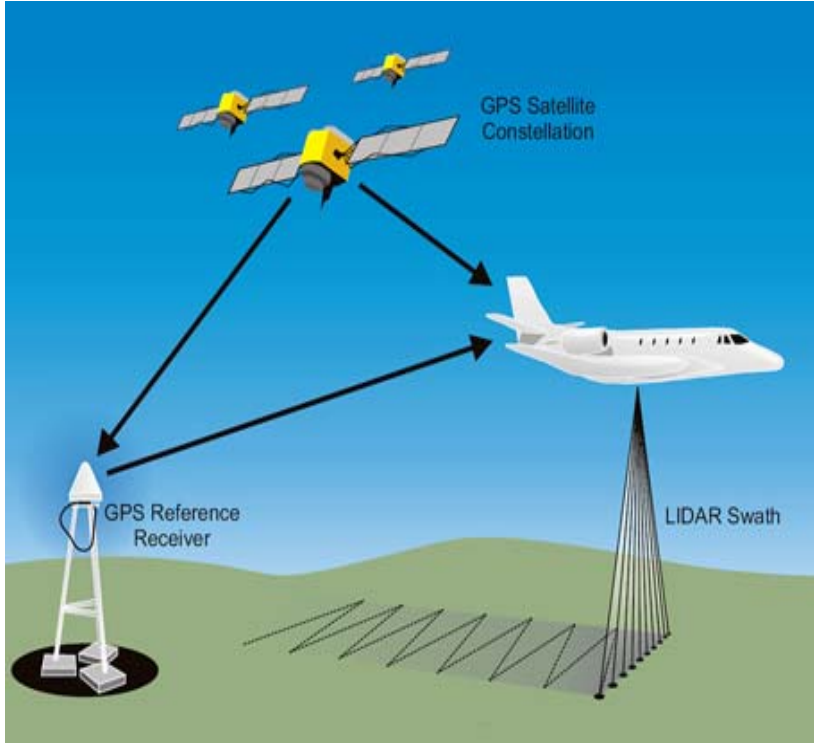


# Identification of Potential Areas Prone to Large-scale Landslide

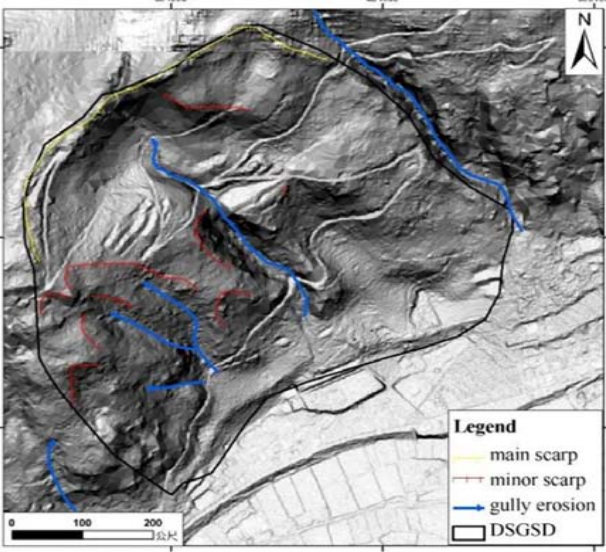
- 9,848 potential areas are located by CGS, Forestry Bureau, and SWBC using **Airborne Lidar Techniques**.
- 34 priorities are chosen for special treatments including on-site monitoring and engineering.

## Light Detection & Ranging (LiDAR)

Lidar is commonly used to make high-resolution **DEM** (digital elevation model)



Modified from Varnes, 1978



1-m DEM

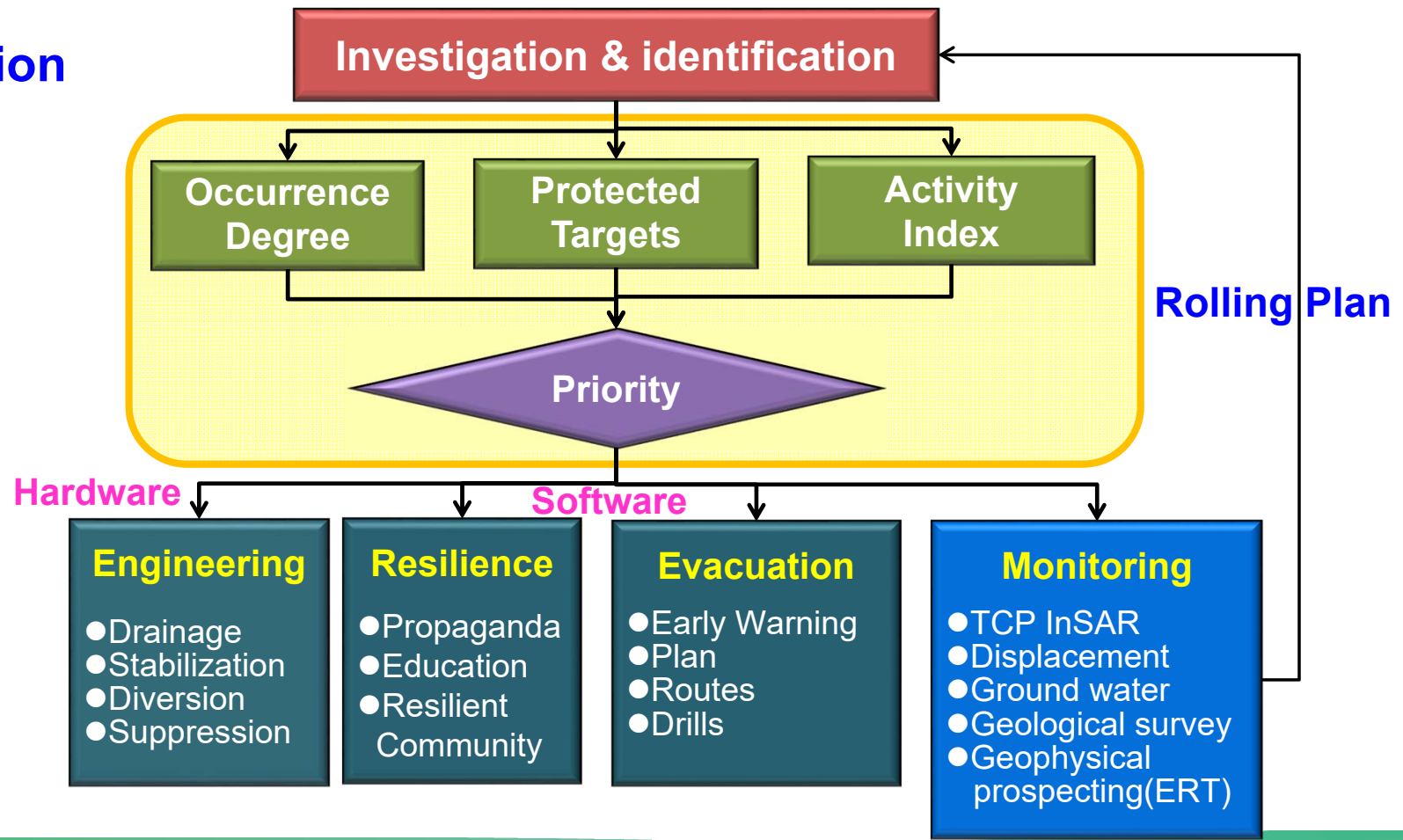


# Framework of Large-scale Landslide Hazard Mitigation

Risk Identification

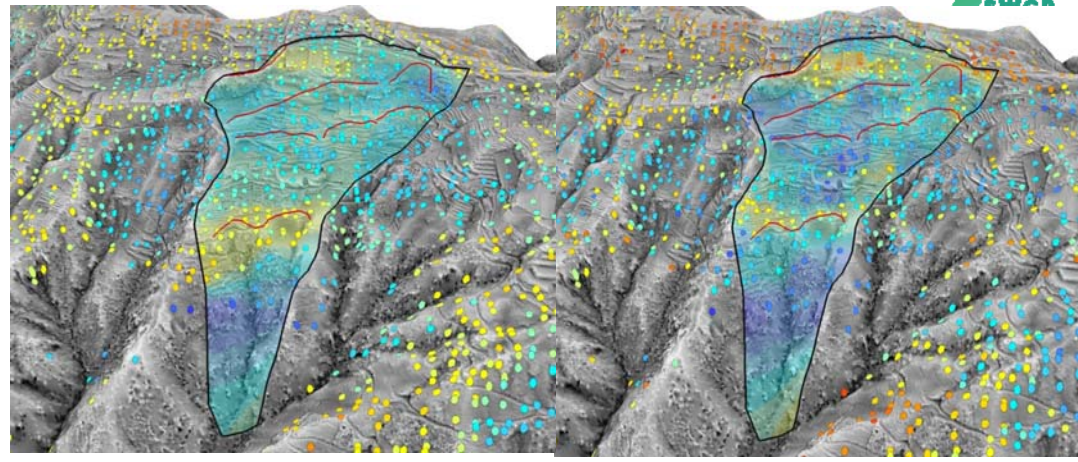
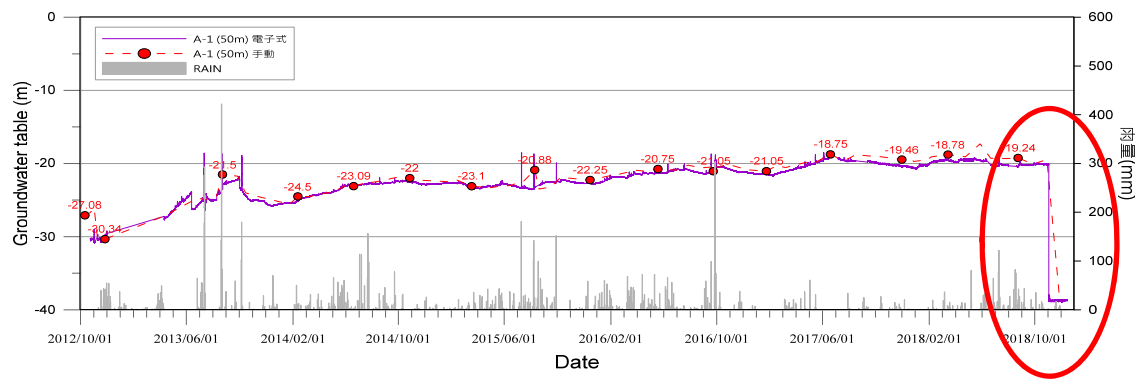
Risk Analysis

Risk Disposal

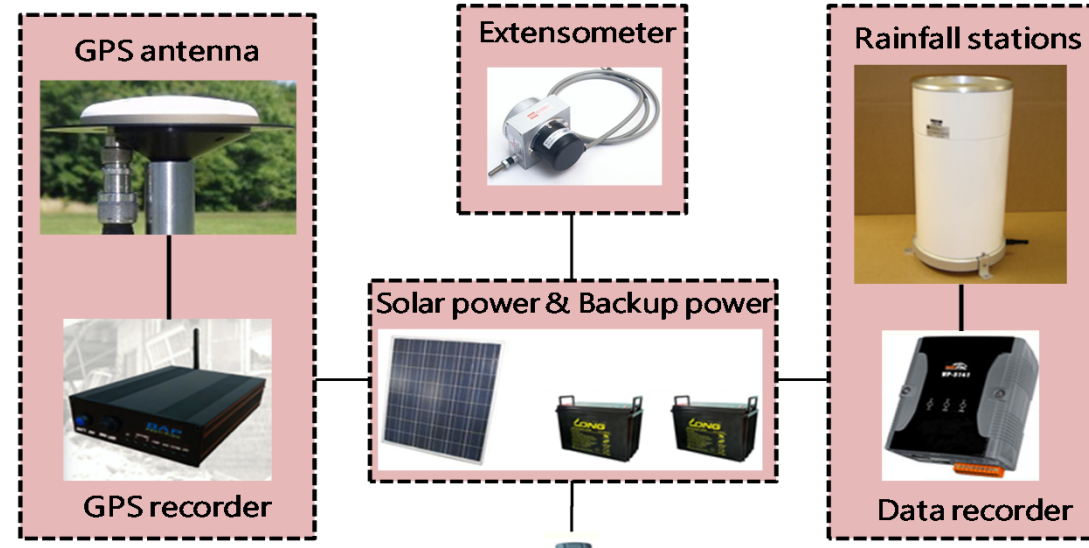




# Groundwater Collecting Well

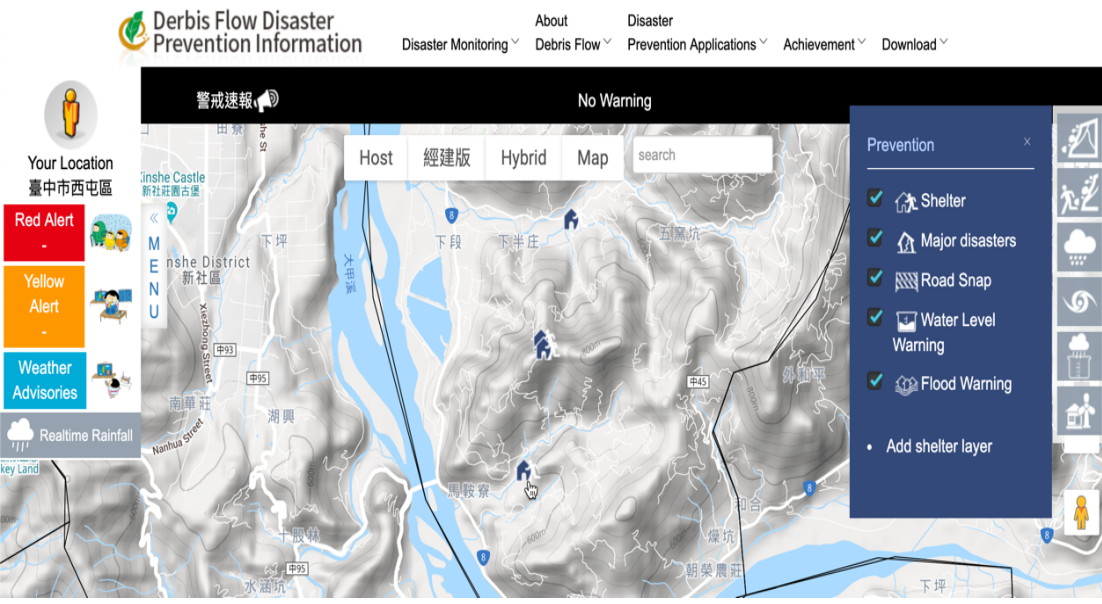


## TCP InSAR for Surface Deformation Detection



## Surface Displacement Monitoring

# 2019-2020 OGC Disasters Resilience Pilot User Guide: Landslide - Early Response and Evacuation Under Limited Bandwidth


Call For Participation:  
OGC Disaster Pilot 2021

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