2012 International Training Workshop for Natural Disaster Reduction

Session 3: Integrated national basis information on GIS

What Kinds of Geological Hazard Data In CGS' Database

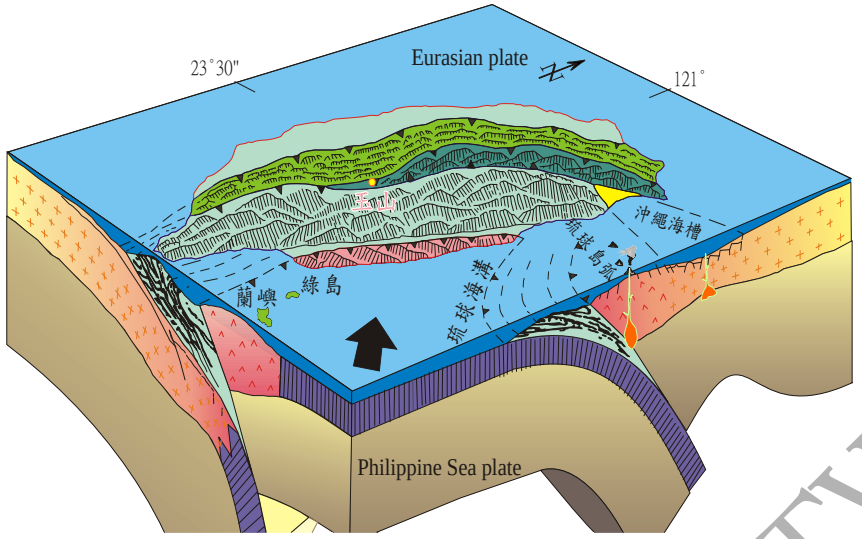
Li-Yuan FEI

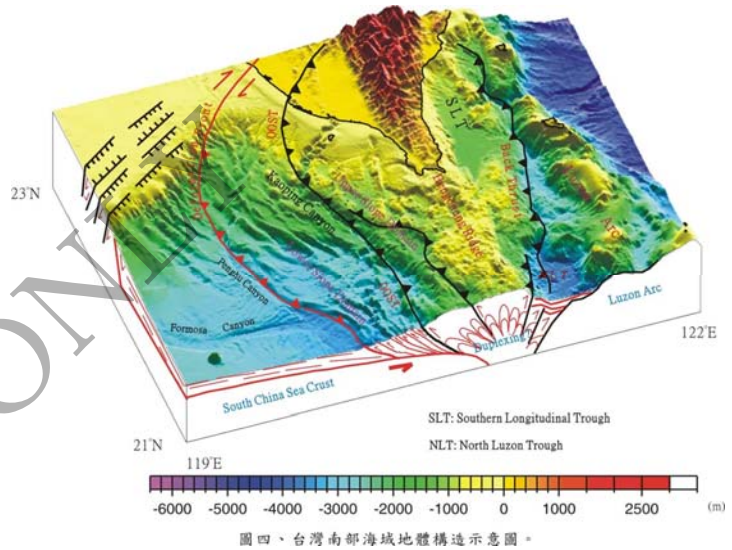
2012/5/15

CONTENTS

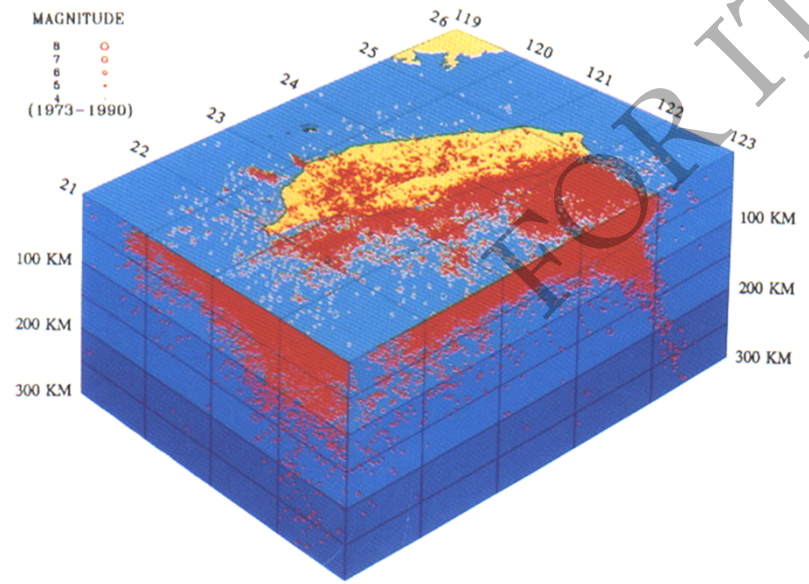
- Active Fault
- Enviro. & Eng. Geology
- Landslide Data before & after the Typhoon Morakot
- Geology Act

The Results of Active Plate Tectonic Movements in Taiwan



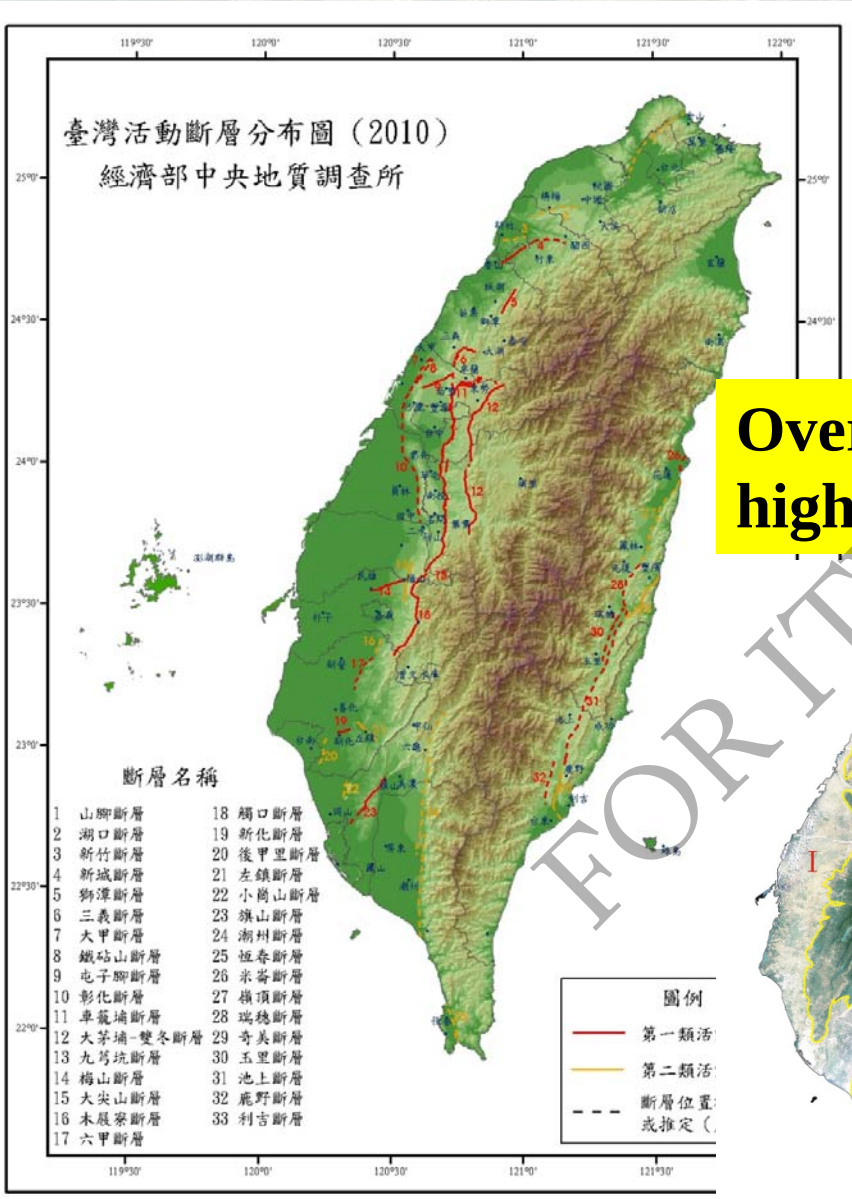


圖四、台灣南部海域地體構造示意圖。

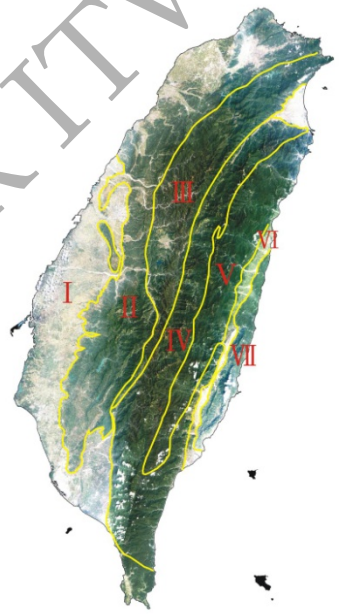


http://www.aifang.info/blog/archives/tag/%E8%BB%8A%E7%A6%8D

＞33 Active Faults locating in Taiwan



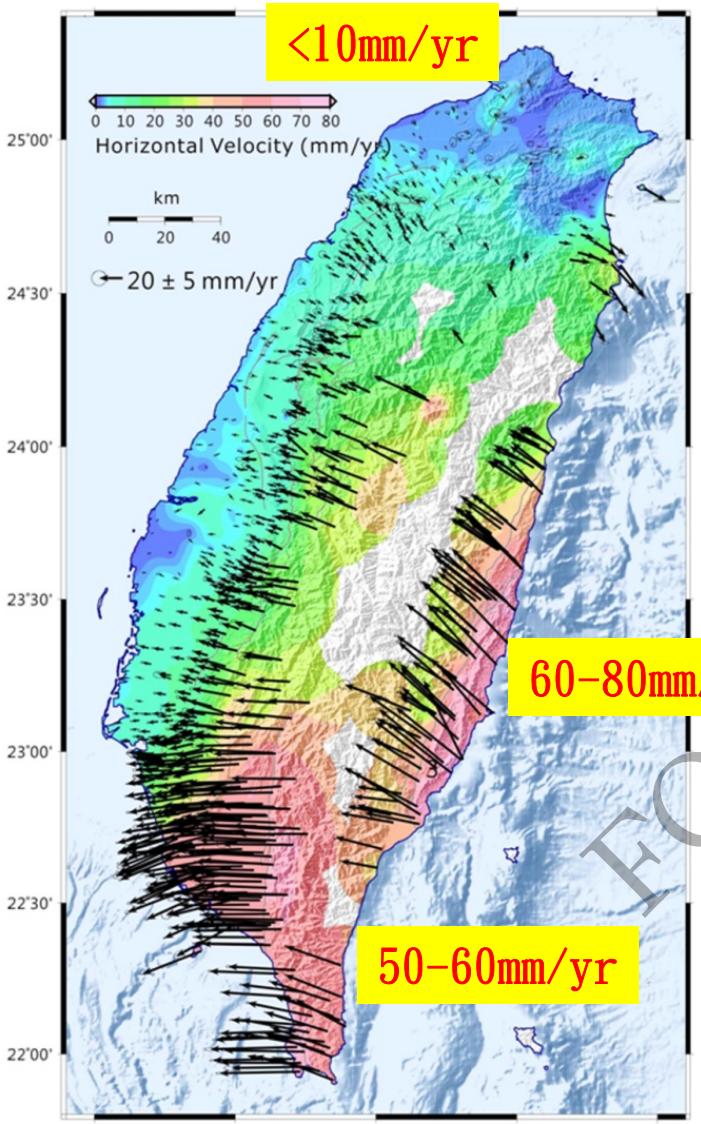
Over 75% of highlands



(1999 Chelungpu Fault)

Active Fault

Horizontal Displacements analyzed by GPS Data in Taiwan from 2002~2011



◆Continuous Observation：

- 67 Continuous record GPS stations
- 8 Geochemical sampling stations
- 13 Borehole strain-gauge stations

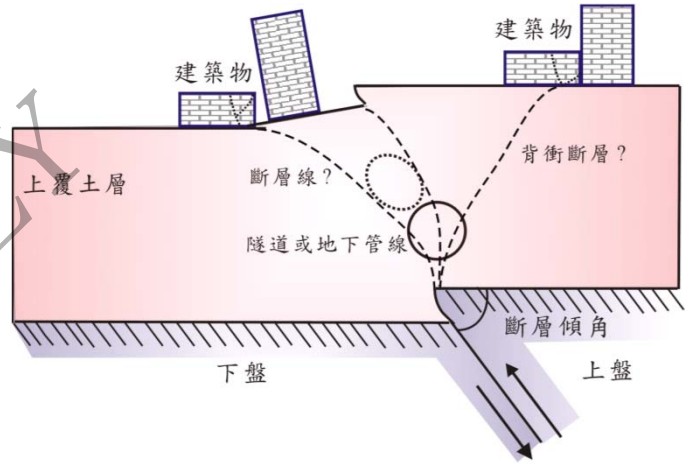
◆Measurment once per year：

- 850 points for GPS to measure
- 41 Lines, about 1,000km long for levelling measurement across the active faults

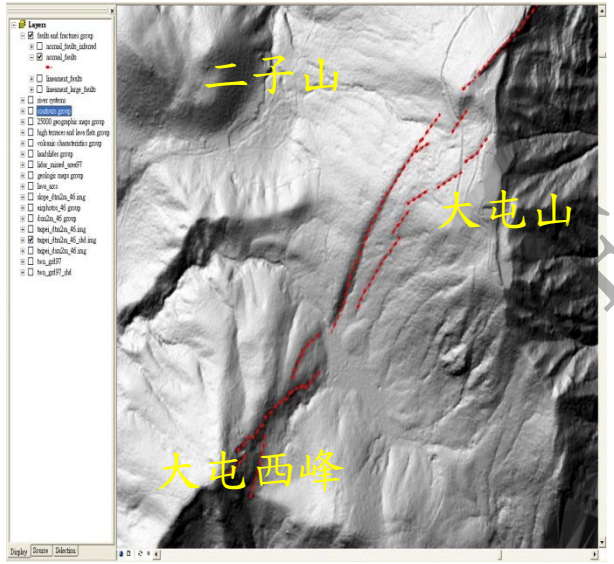
＊All Active Fault slides provided by the Active Tectonics Division, CGS

The Structural Characteristics of Active Faults

- How the soil bed influenced by the fault movement

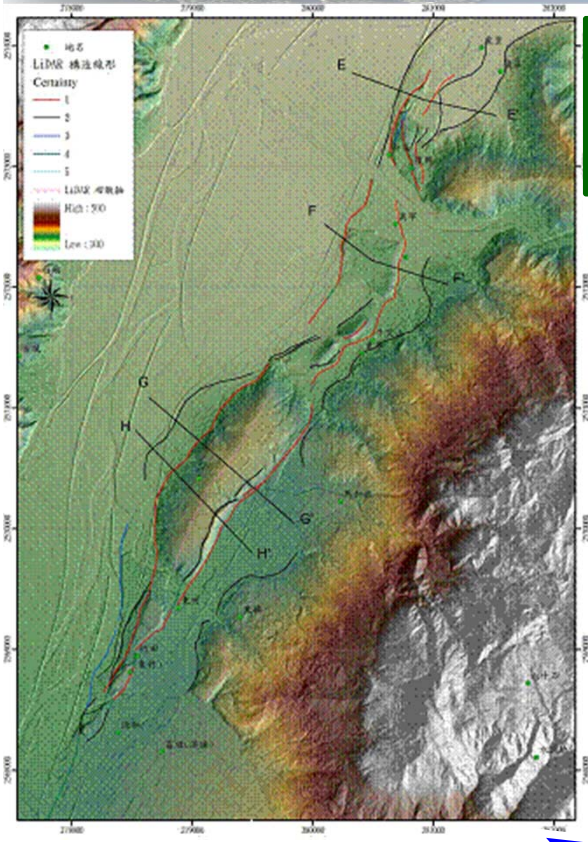


- Identifying the geomorphologic signs by using 5m×5m DEM

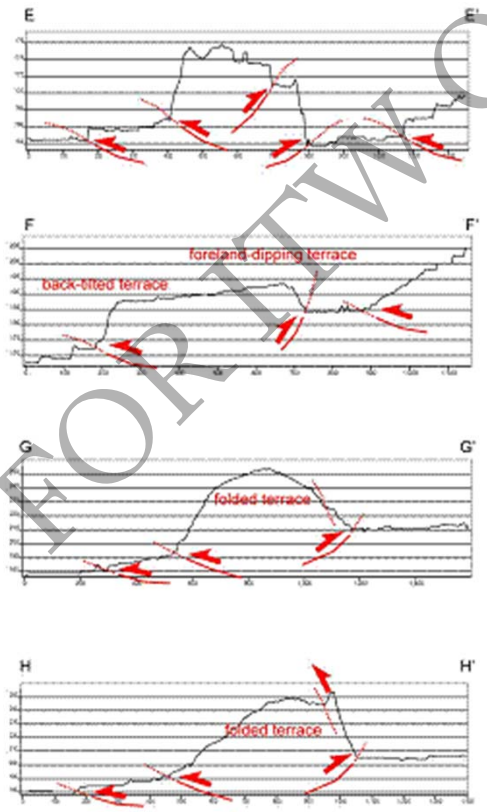


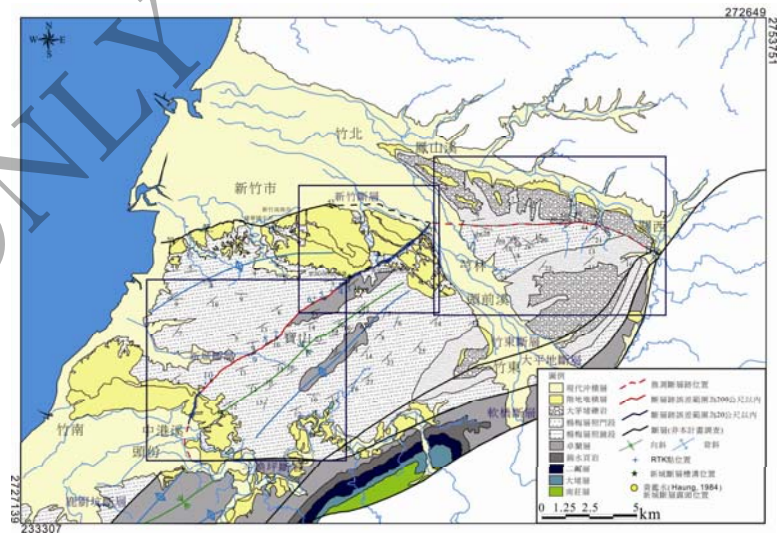
- Locating the faultline position and investigating the activities of active faults

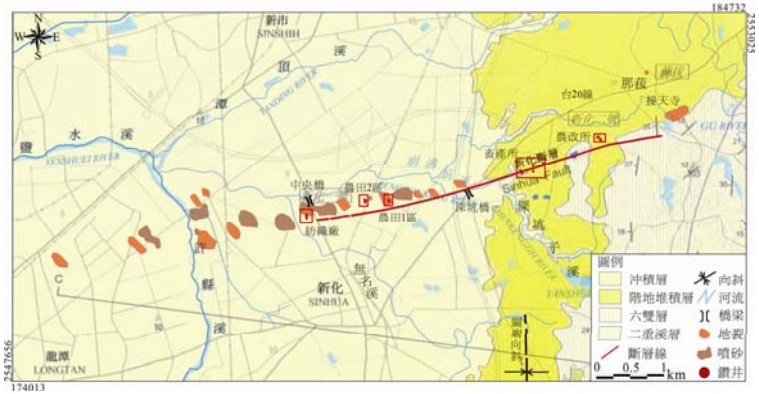
- Database renewing



Locating the accurate position of active faults
Investigating the activities of active faults







Identifying the geomorphologic evidences of faults by using 5m × 5m DEM

Central Geological Survey

1867.12.18

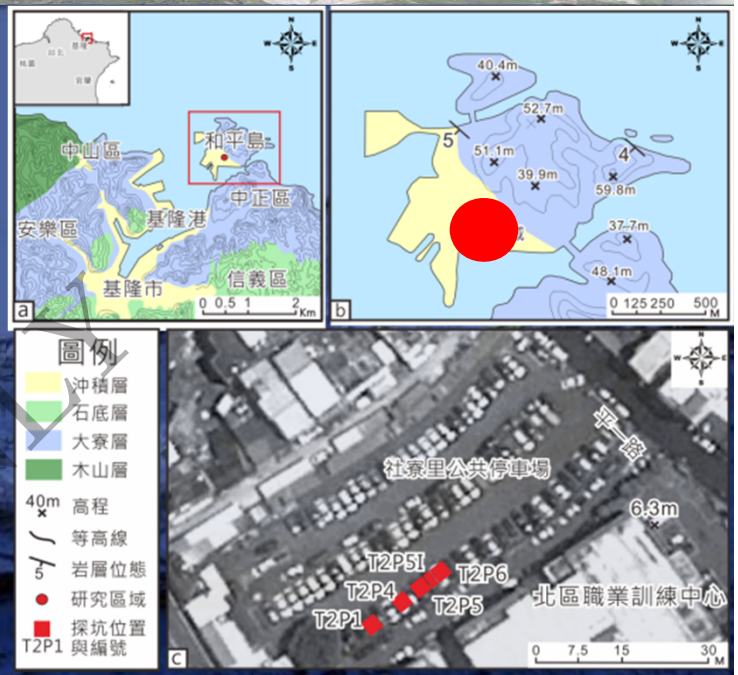
1866

1792

1721

1661

1781



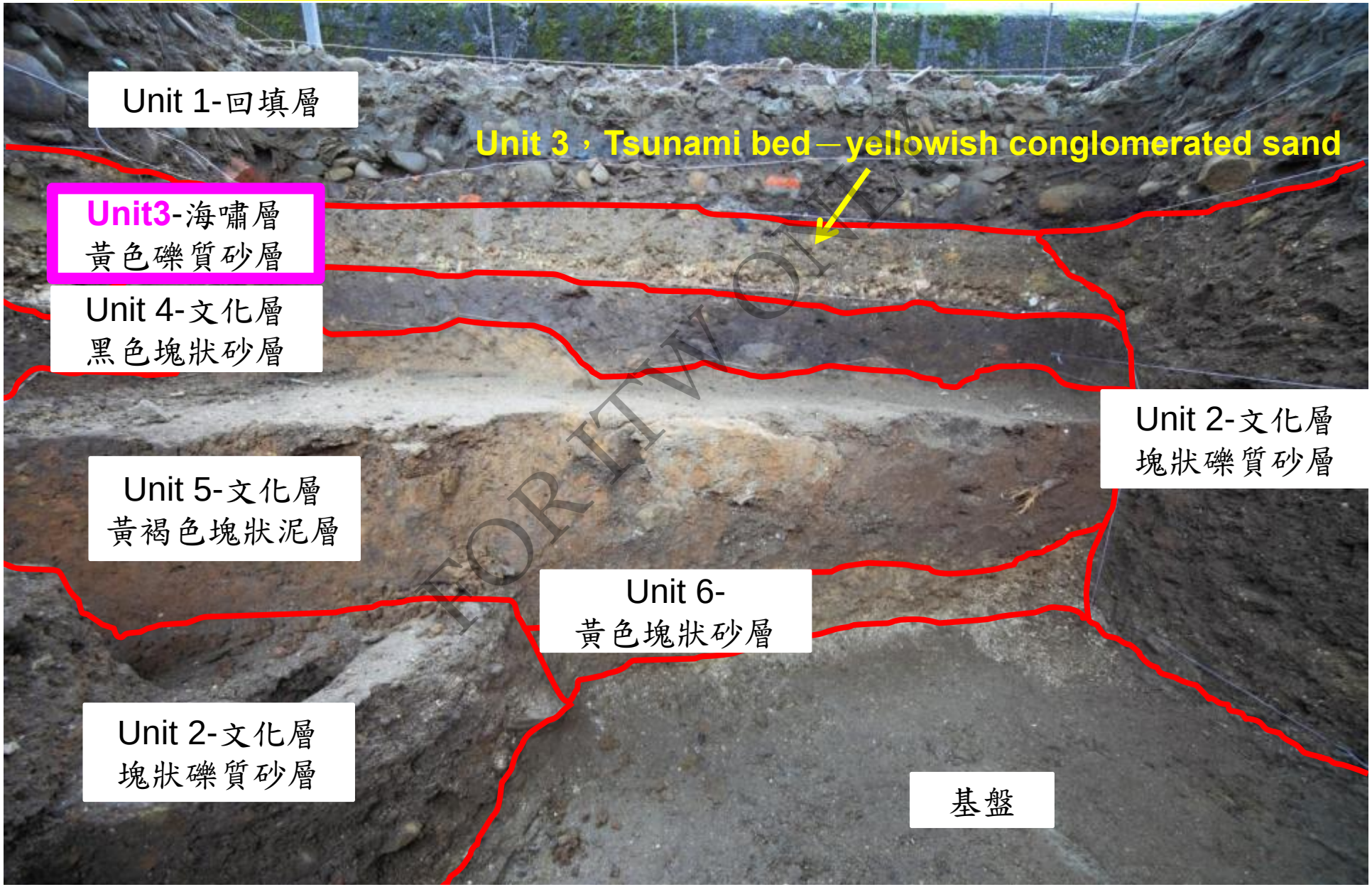
Ho-Ping Island, Keelung City

Tsunami records from historical documents in Taiwan

Central Geological Survey, MOEA
The Institute of History and Philology, Academia Sinica
Dep. of Foreign Languages and Literatures, NTU

Central Geological Survey

The sedimentary sequences in the soil profile



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盧詩丁、朱傚祖、
劉彥求、林燕慧、
陳柏村、黃志遠、
姜彥麟(2012)

Tsunami Evidence of 1867.12.18？

Ancient current directions of Unit 3

Landward ← → seaward

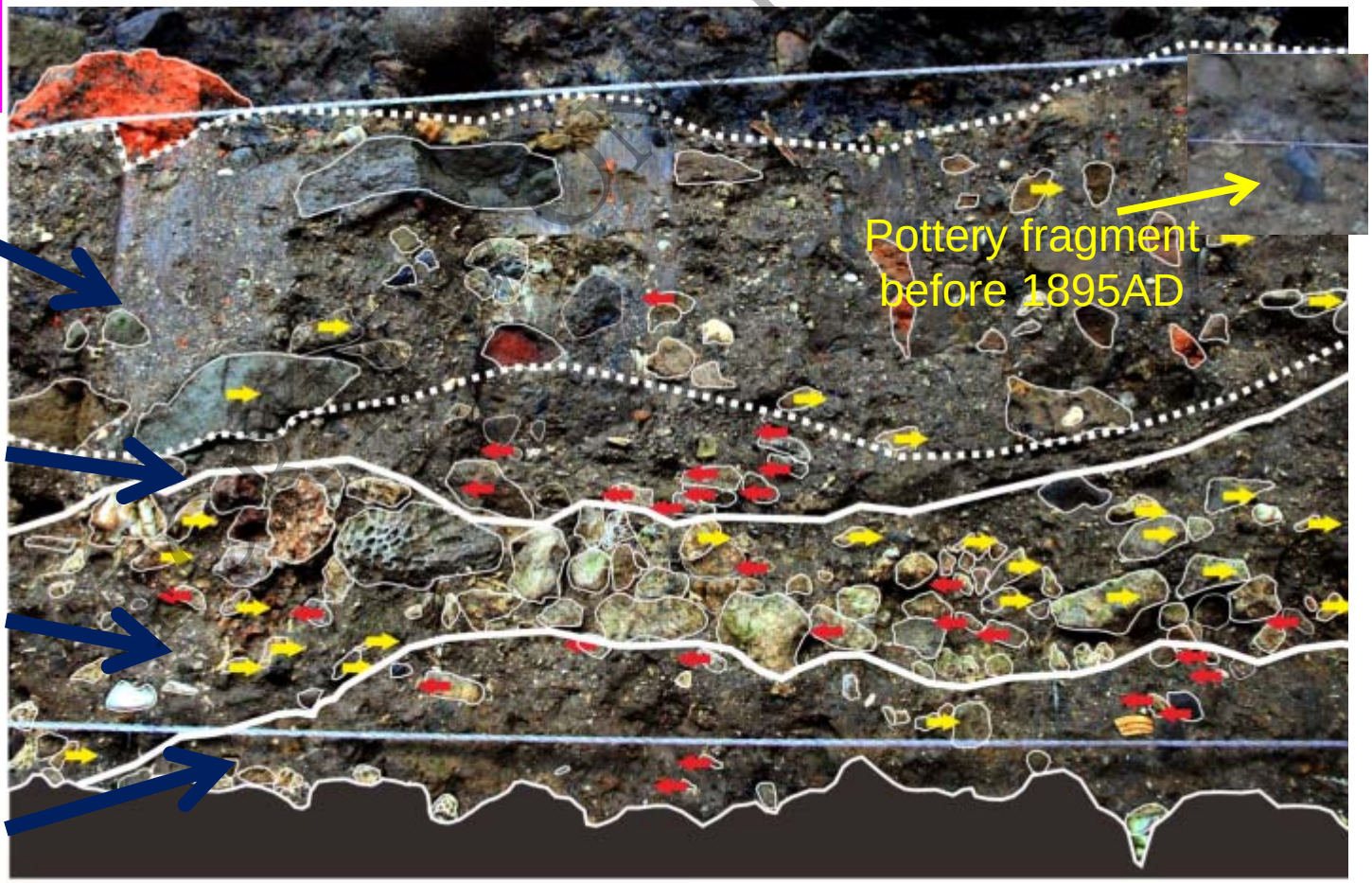
第四層: N=8 D=SW

Unit 3

第三層: N=8 D=NE

第二層: N=26 D=SW

第一層: N=10 D=NE



Enviro. & Eng. Geology

PROJECT(2002~2010)

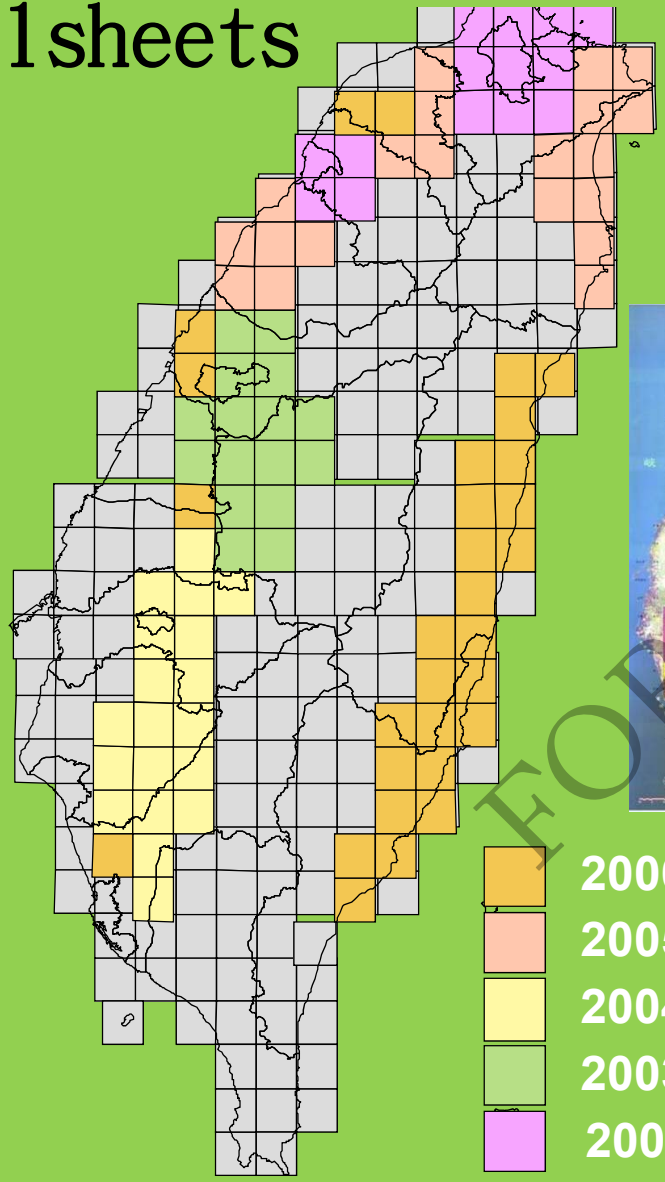
Monitoring and Evaluating Landslide Hazard Potential on Sensitive Areas of Geological Disaster Mapping of geological hazards in urban & mountainous areas

The goals of the project :

1. Identifying hazard areas of the slope land.
2. Establishing an integrated geological database for hazard prevention.
3. Geological hazard zoning evaluation for villages & public constructions.
4. Providing many kinds of geological hazard information.
5. Promotion and education the citizens for hazard prevention and self management.

Slope land near urban areas

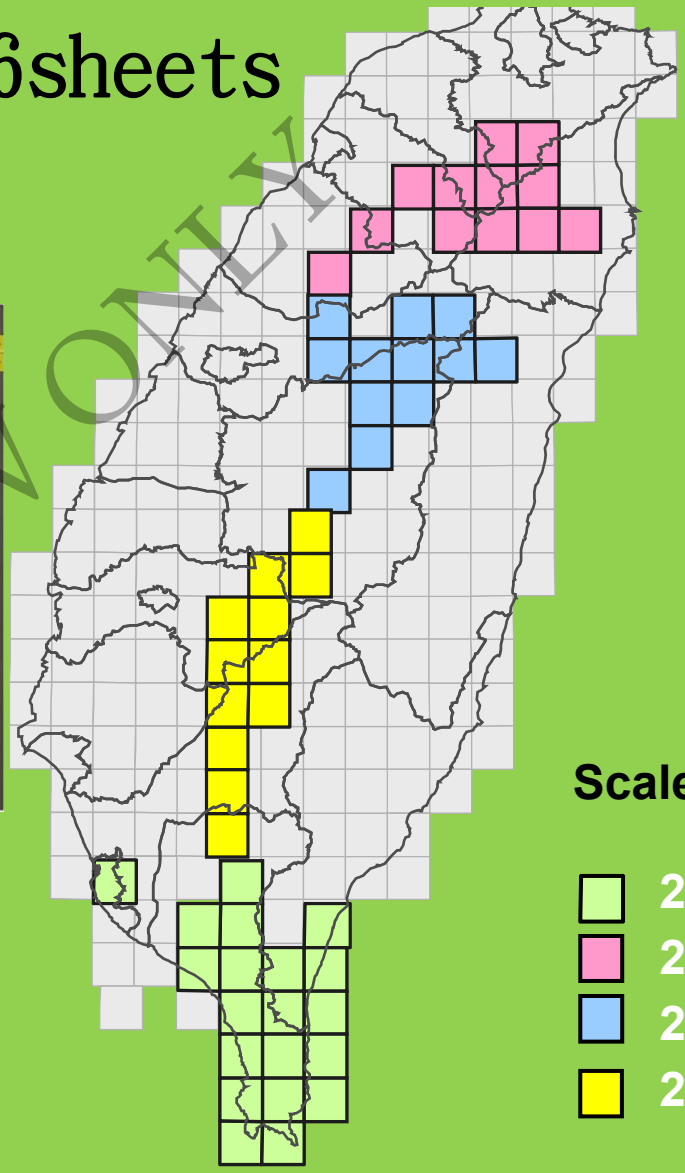
101sheets



2006
2005
2004
2003
2002

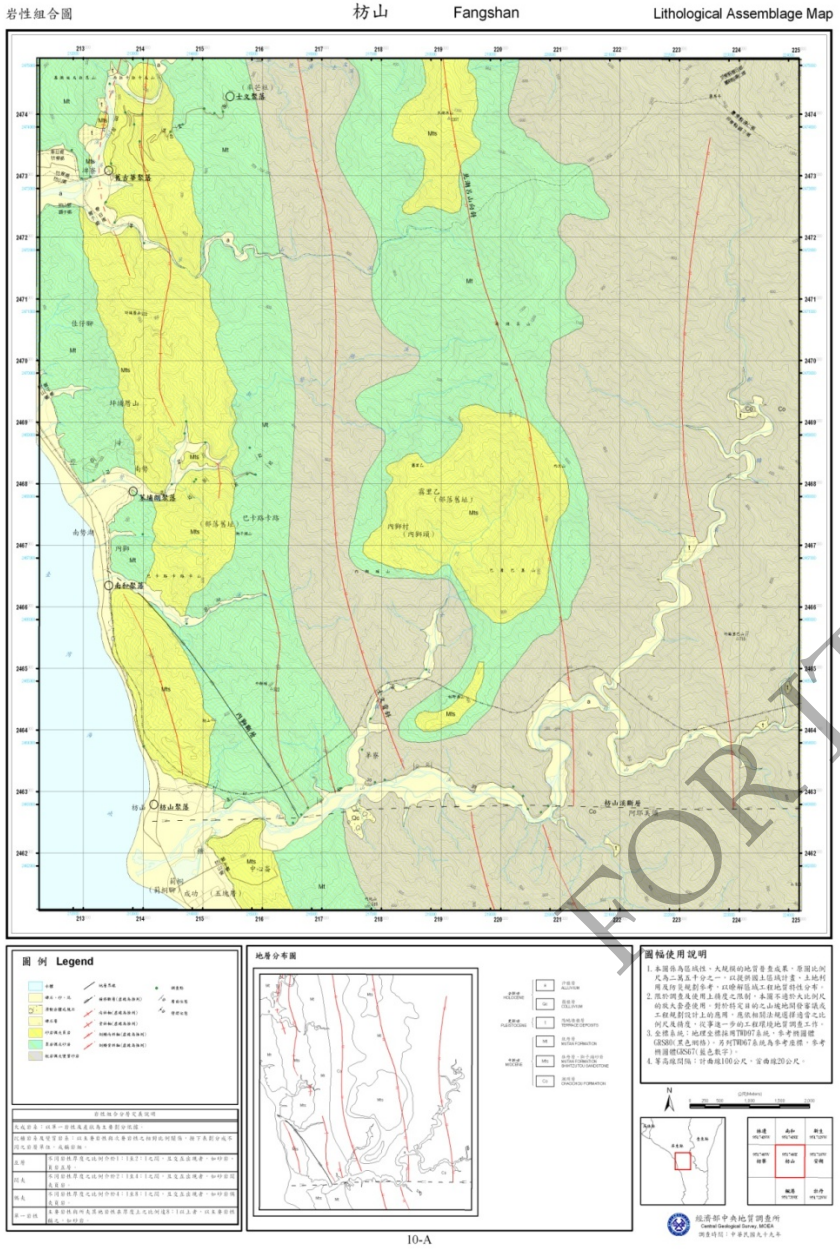
Villages in the mountain areas

56sheets



Scale 1/25,000

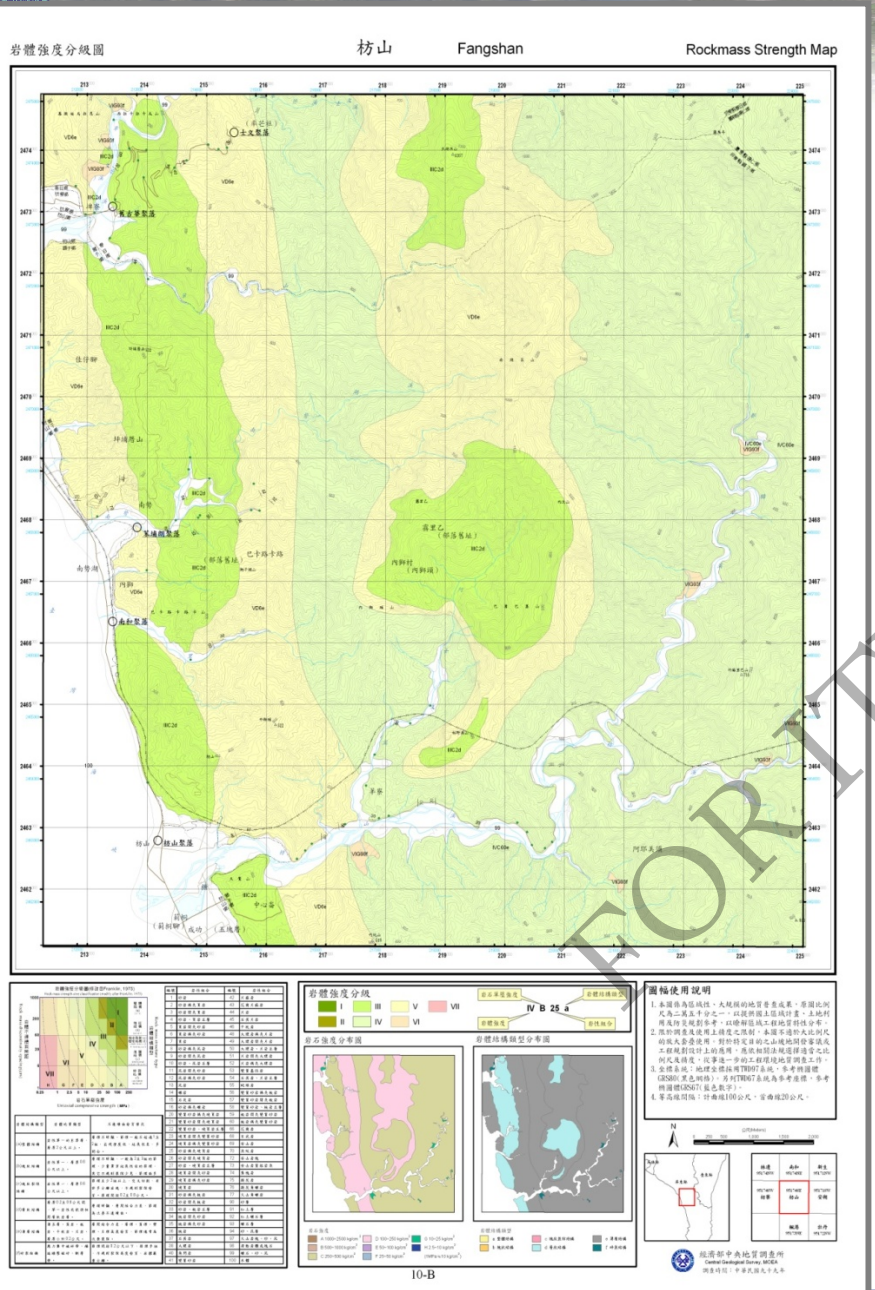
2010
2009
2008
2007



Lithological Unit Distribution Map

Lithological Unit Delineation

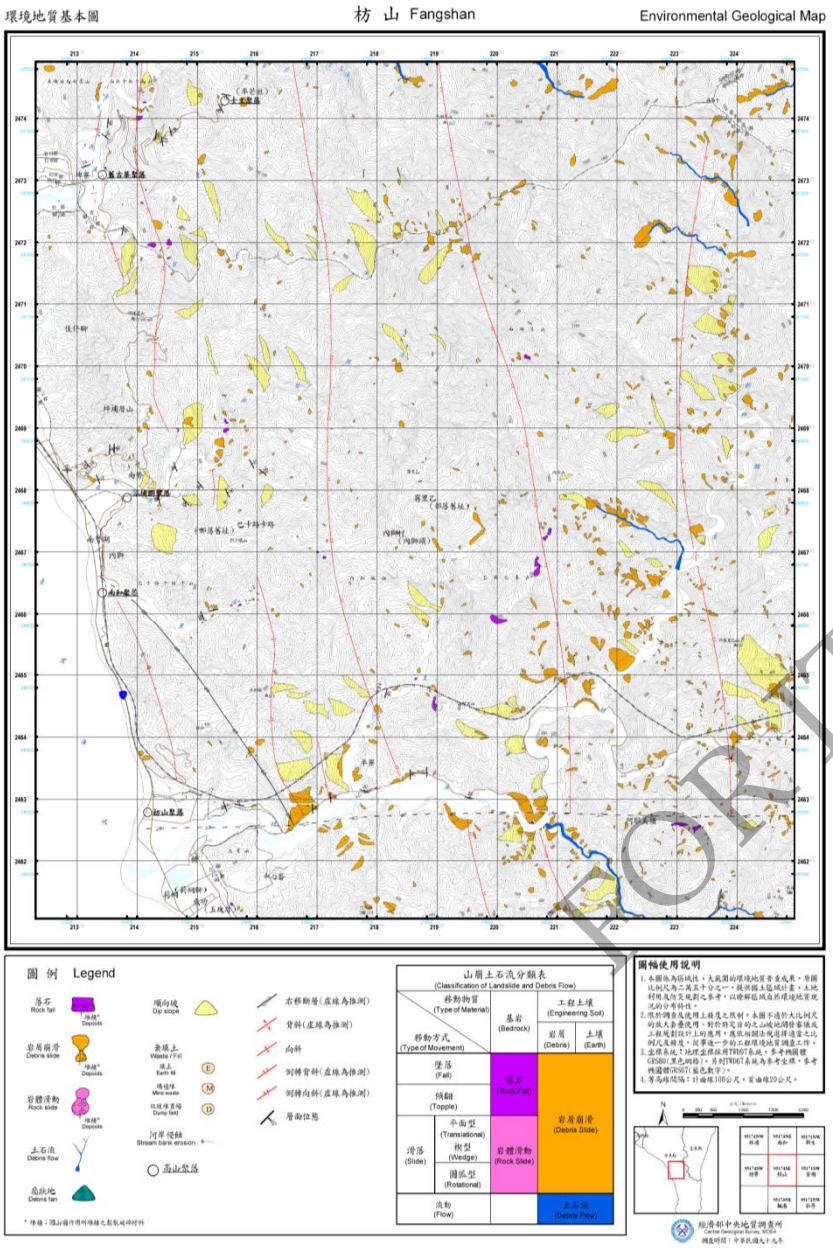
- Rock unit differentiating
- Rock units and geological structures tracing
- Lithologic unit distribution mapping



Rock Mass Strength Classification Map

Rock Mass Engineering Investigation

- Rock mass strength tests in lab. and field
- Rock mass strength classification mapping



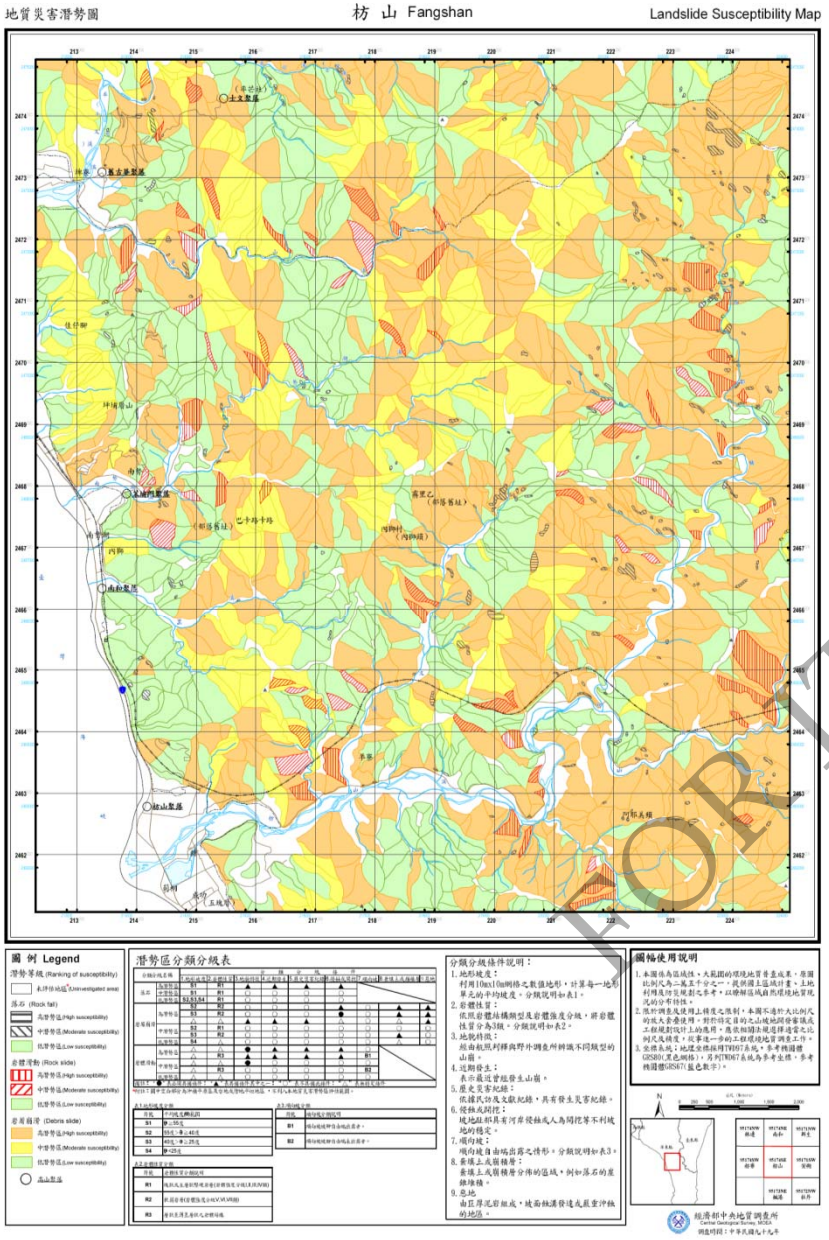
Slope Land Environmental Geological Basic Map

Environmental Geology Investigation

- Establishing historical hazards database
- Mapping for shading map
- Slope land environmental geological basic data mapping

Factors considered in Environmental Geological Basic Map

- Rock Fall
- Debris Slide
- Rock Slide
- Debris Flow
- Dip-Slope Land
- Colluvium
- Headward erosion
- Stream bank erosion
- Waste / Fill
- Badland, Alluvium

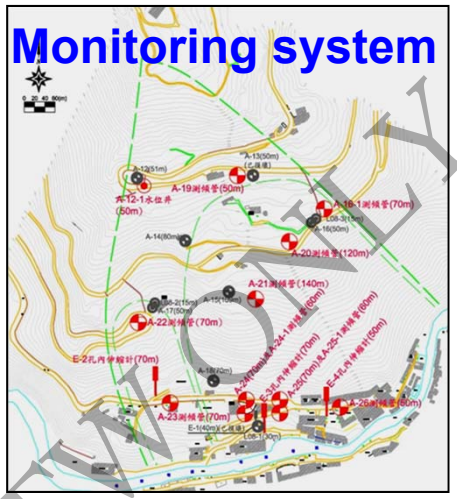


Landslide Susceptibility Map

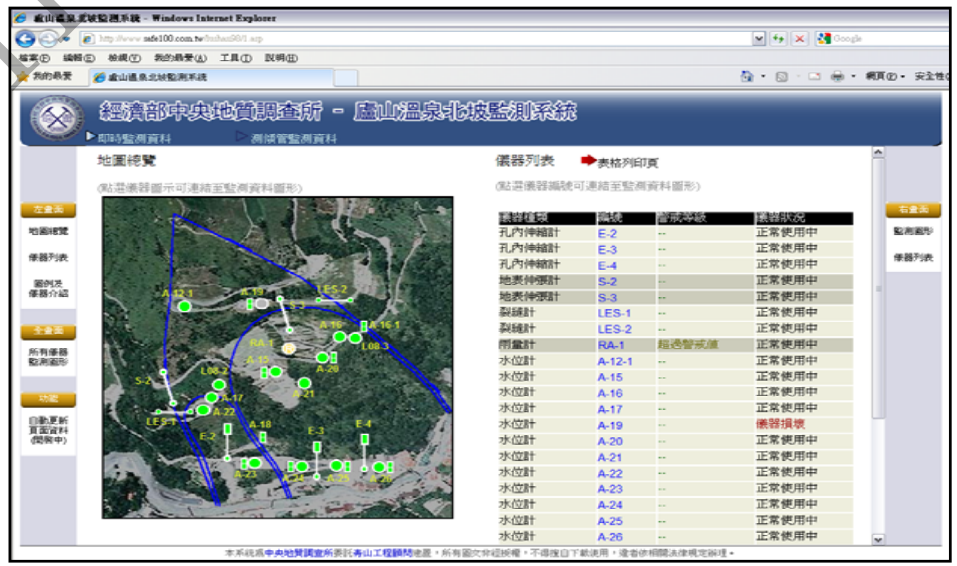
Landslide Susceptibility Analysis

- Slope unit analysis
- Three different kinds of slope failure
- Factor evaluation
- Landslide susceptibility mapping

Monitoring and Precaution System at the northern slope of Lushan Hot spring Area, Nantou county

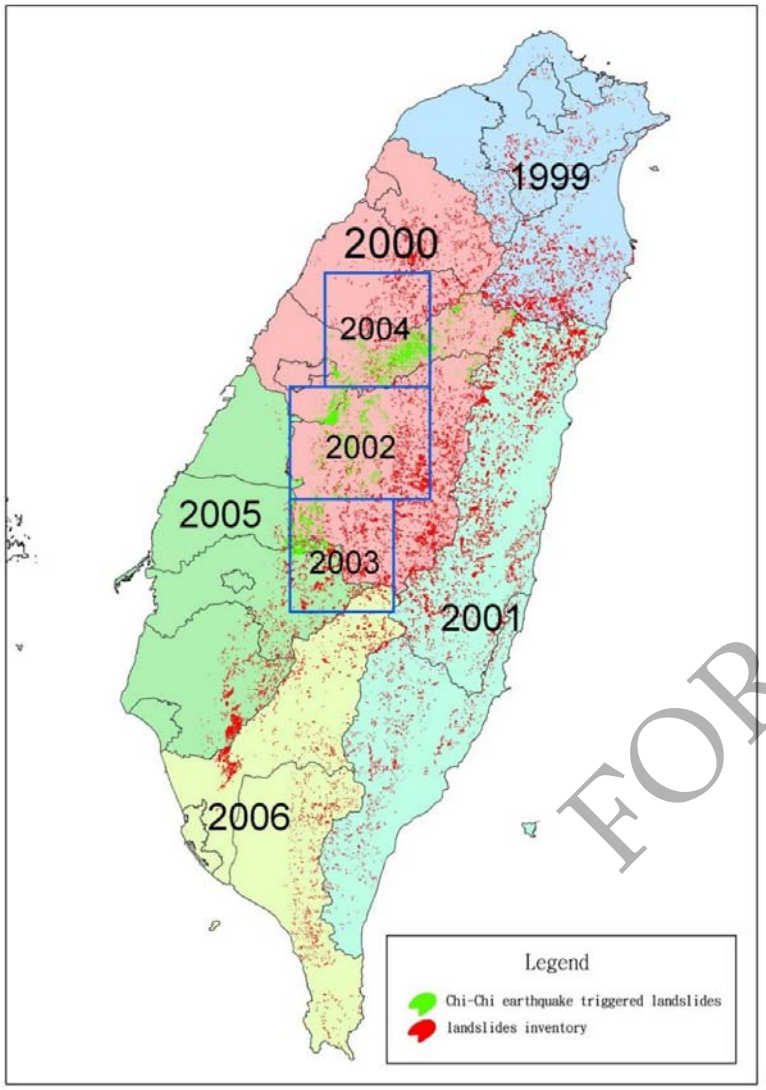


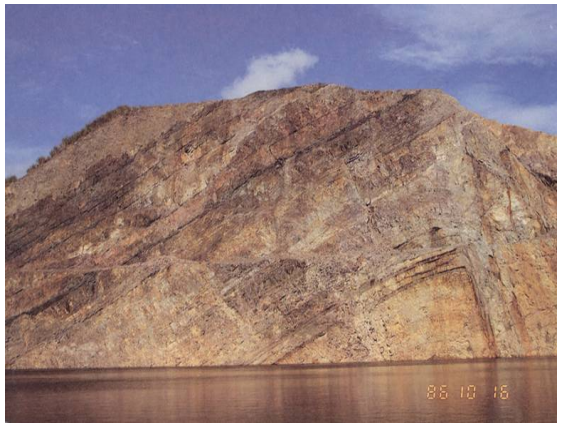
- Establishing the monitoring systems since 2007
- Real-time monitoring data can be transmitted and displayed from website.
- Monitoring Systems cost at least 30~40 millions NT.



Landslide Data before & after the Typhoon Morakot

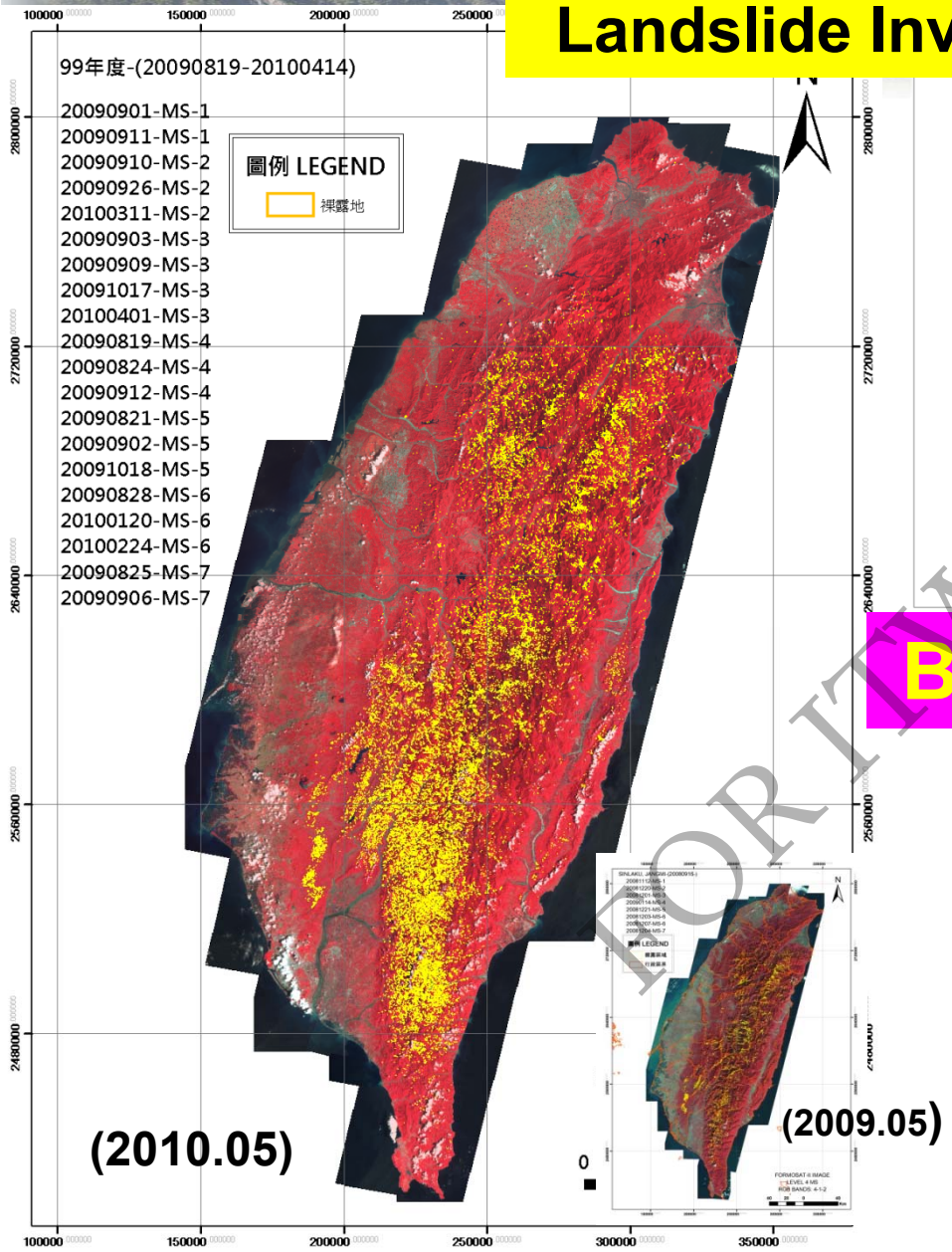
Landslides Inventory in 2000(after Chi-Chi EQ)

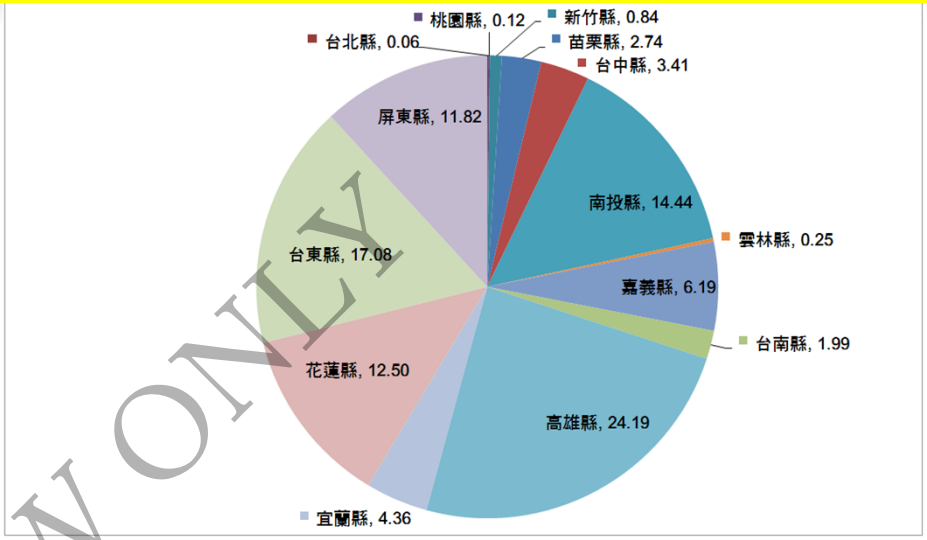




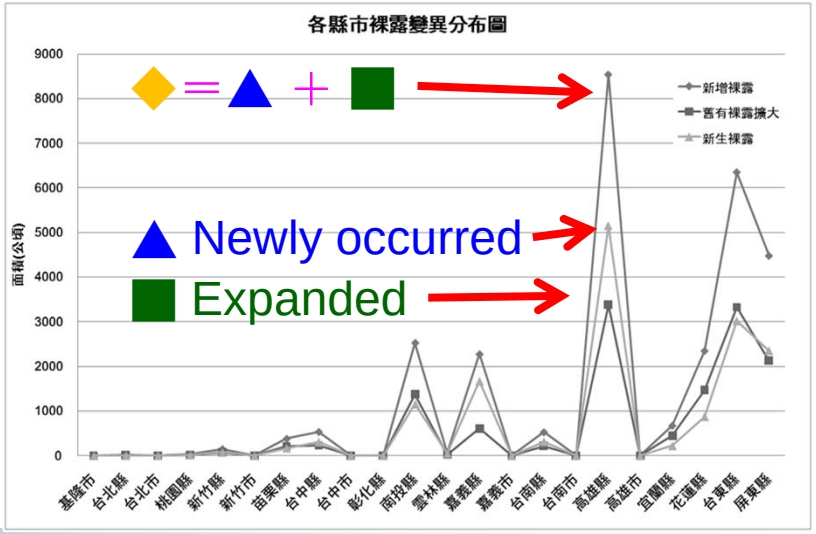
Controlled by many kinds of Geological Factors

Landslide Inventory after Typhoon Morakot



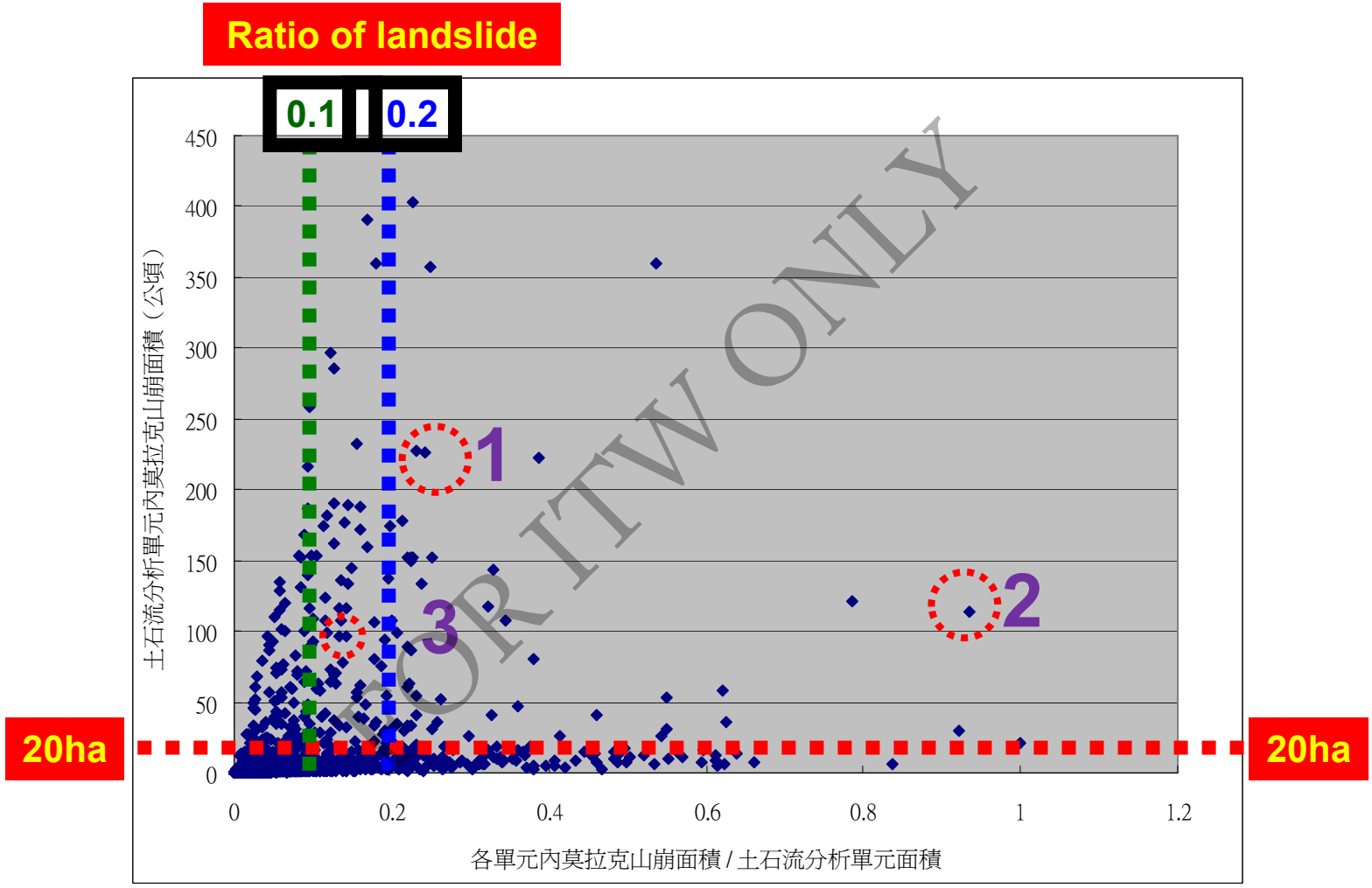


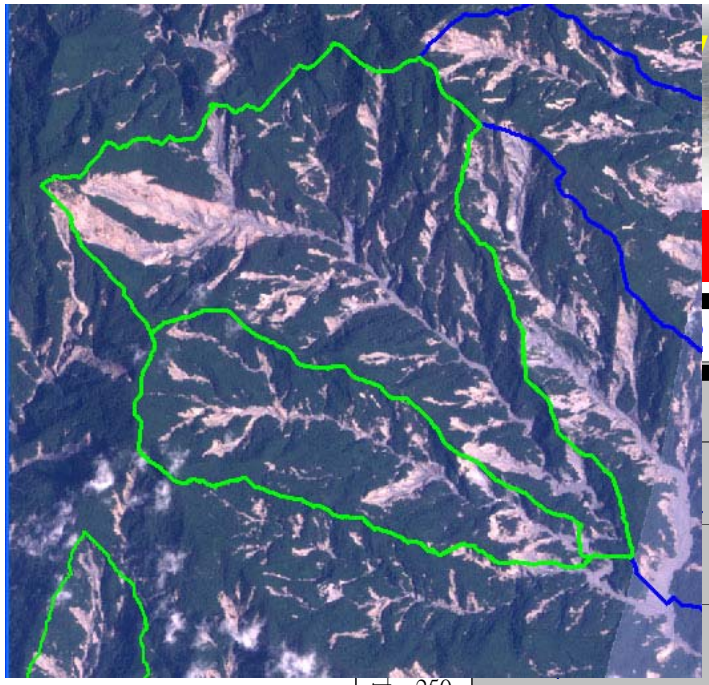
Bareland Area：47,126ha



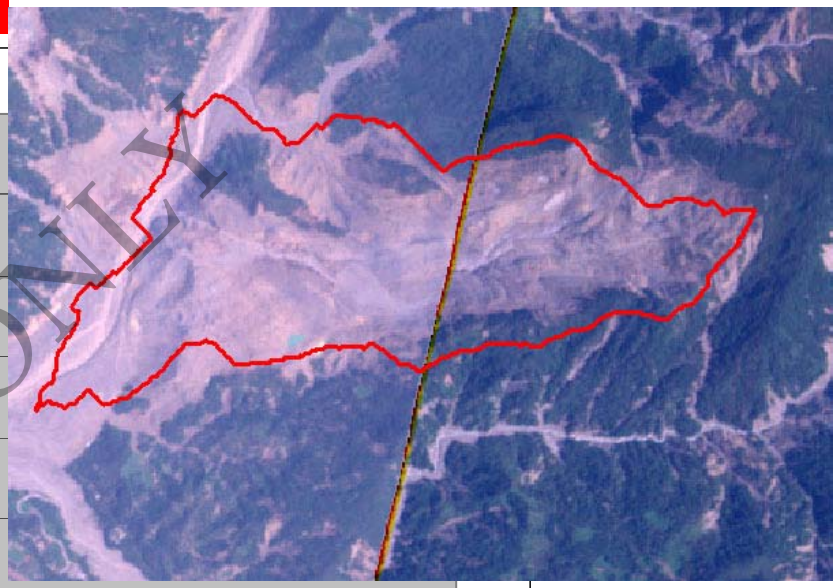
2009. 09 2010. 10 **Chishan river valley(S→N)**

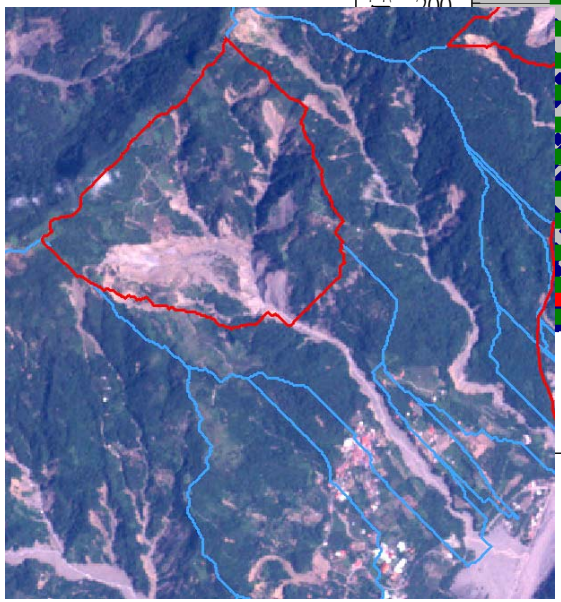
Memory from the Xiaolin Landslide

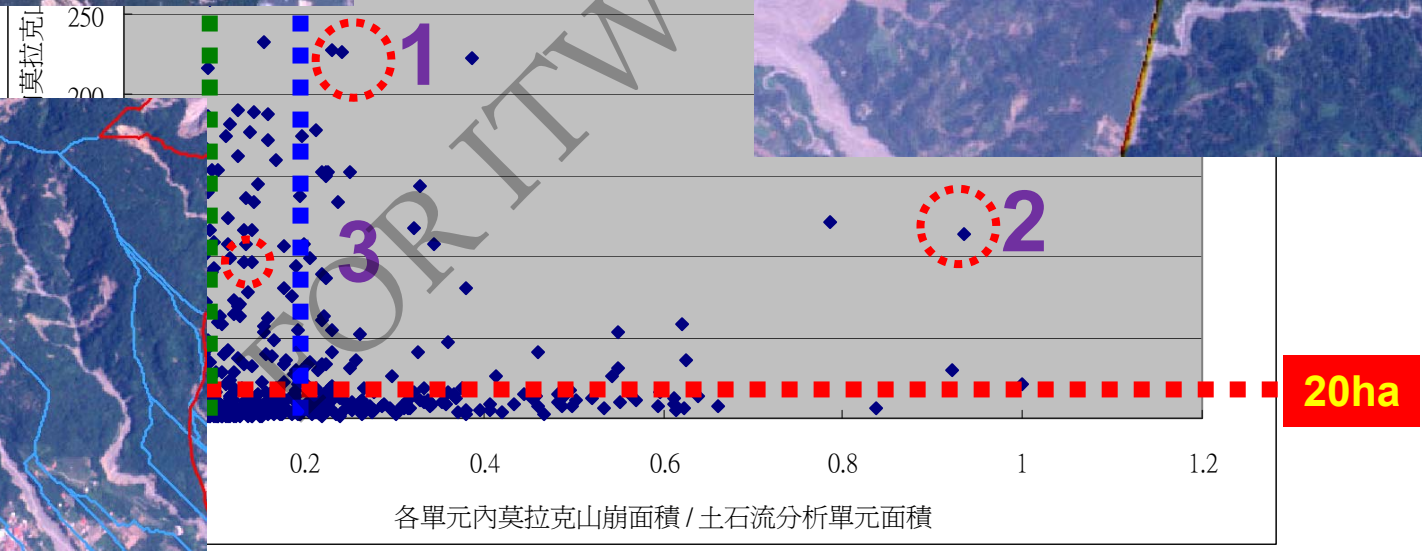

Ratio of landslide
0.1
0.2
1
2
3
20ha
20ha
土石流分析單元內莫拉克山崩面積（公頃）
各單元內莫拉克山崩面積 / 土石流分析單元面積
0
50
100
150
200
250
300
350
400
450
0
0.2
0.4
0.6
0.8
1
1.2



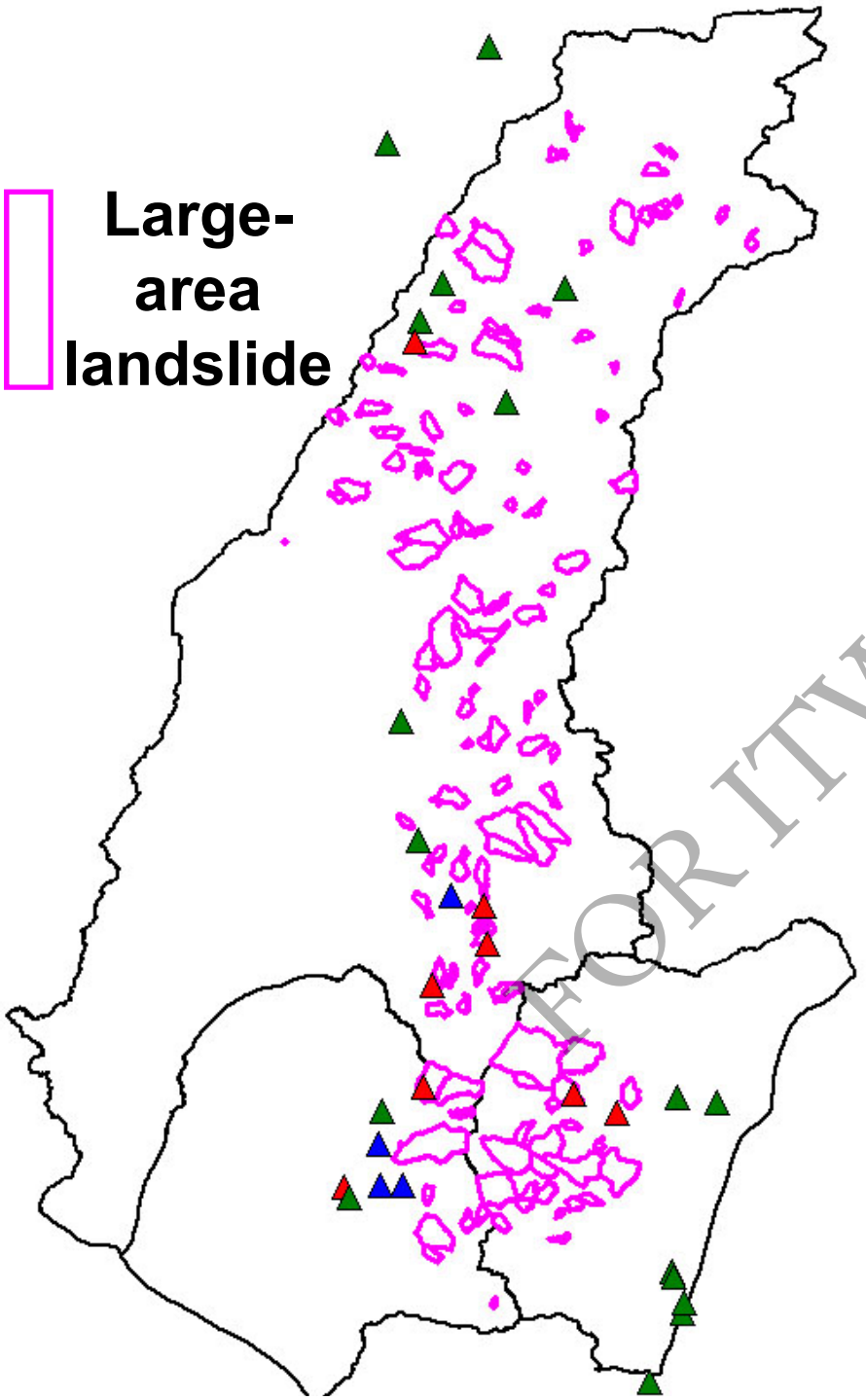
Ratio of landslide







At least occurred 3 types of slope failure

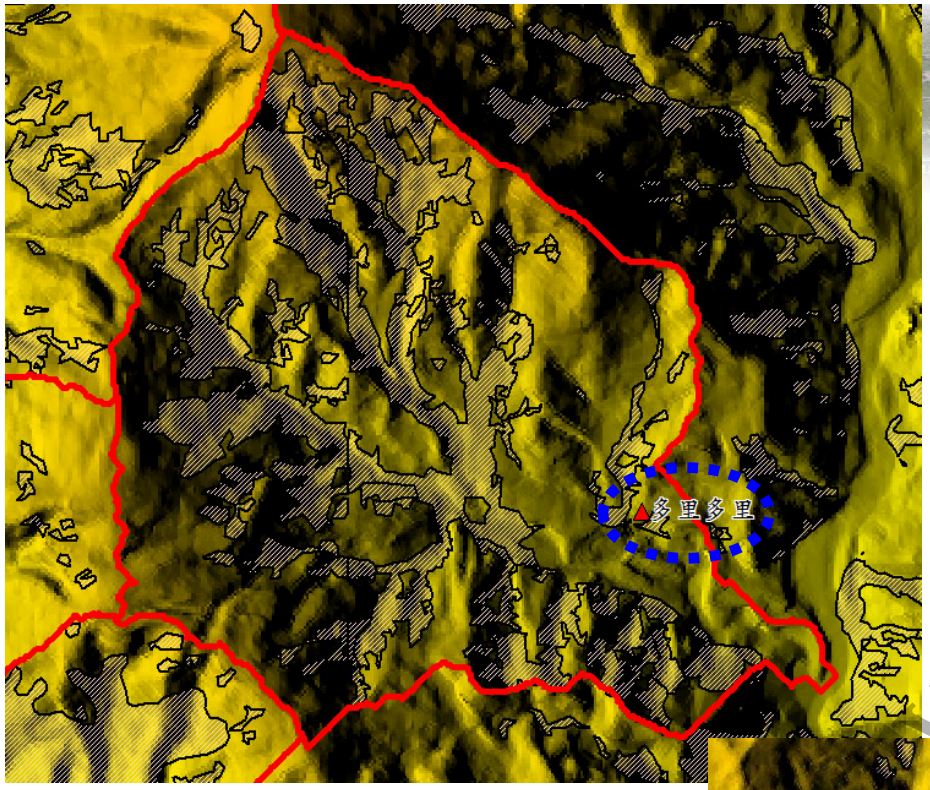


Large-area Landslides vs Aboriginal Villages

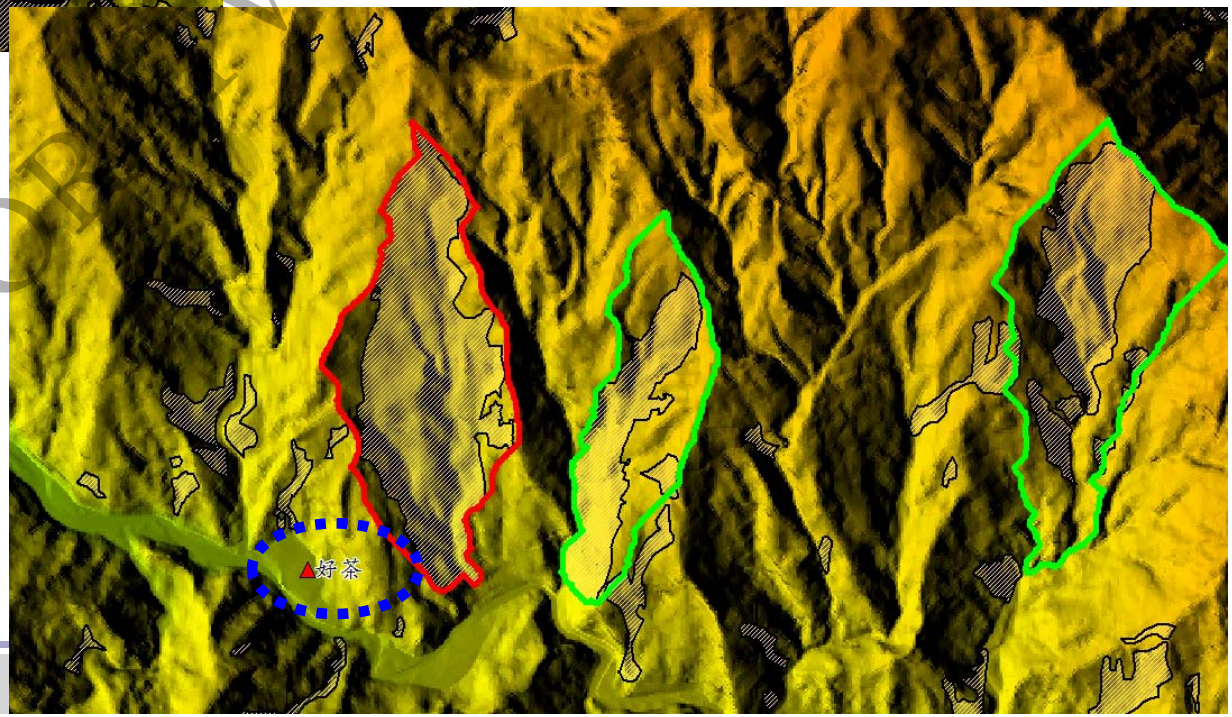
▲ Close to large-area Landslide area

▲ Threatened by the upstream sediments transport

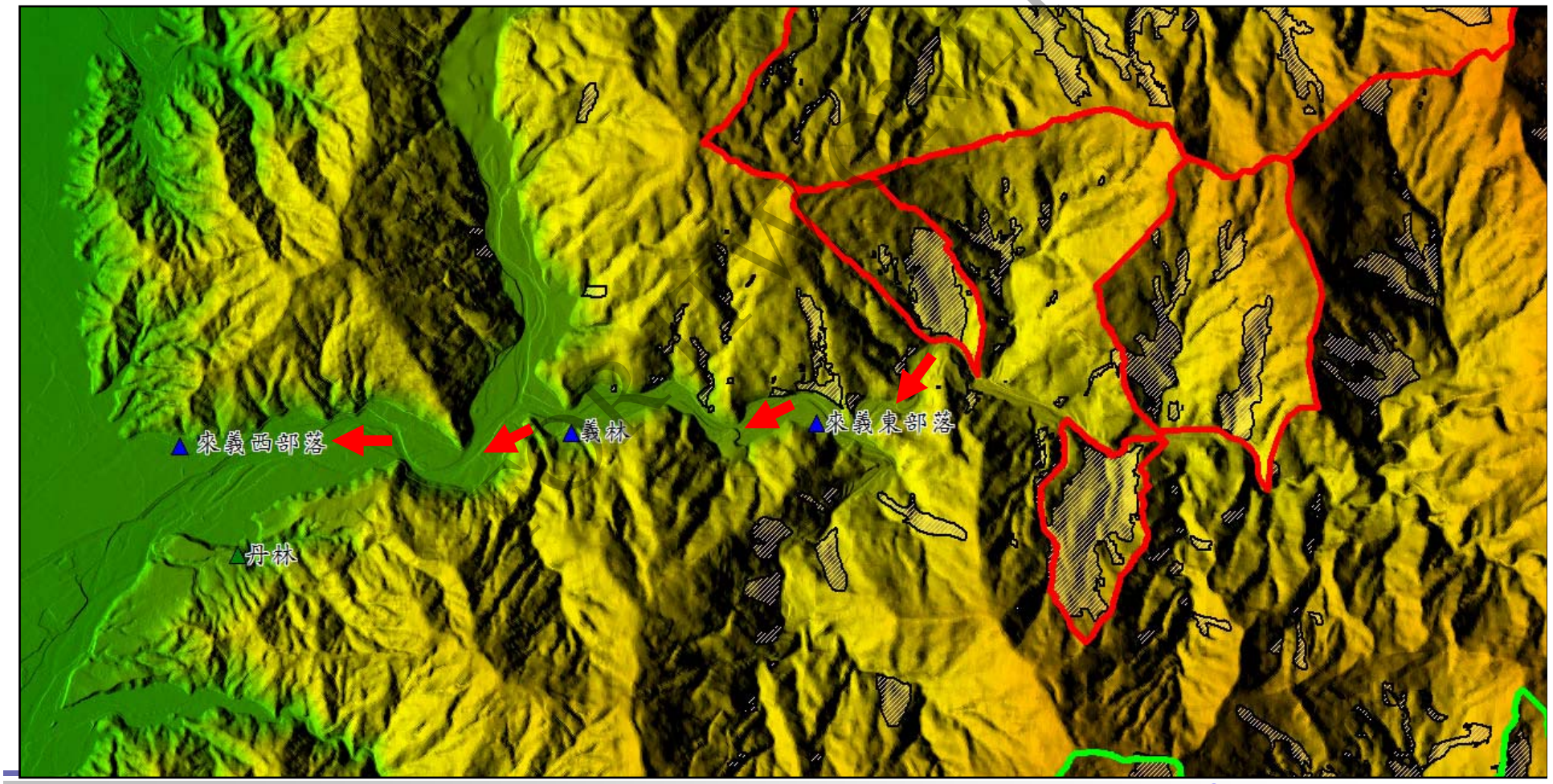
▲ Nearby but not affected by large-area Landslide



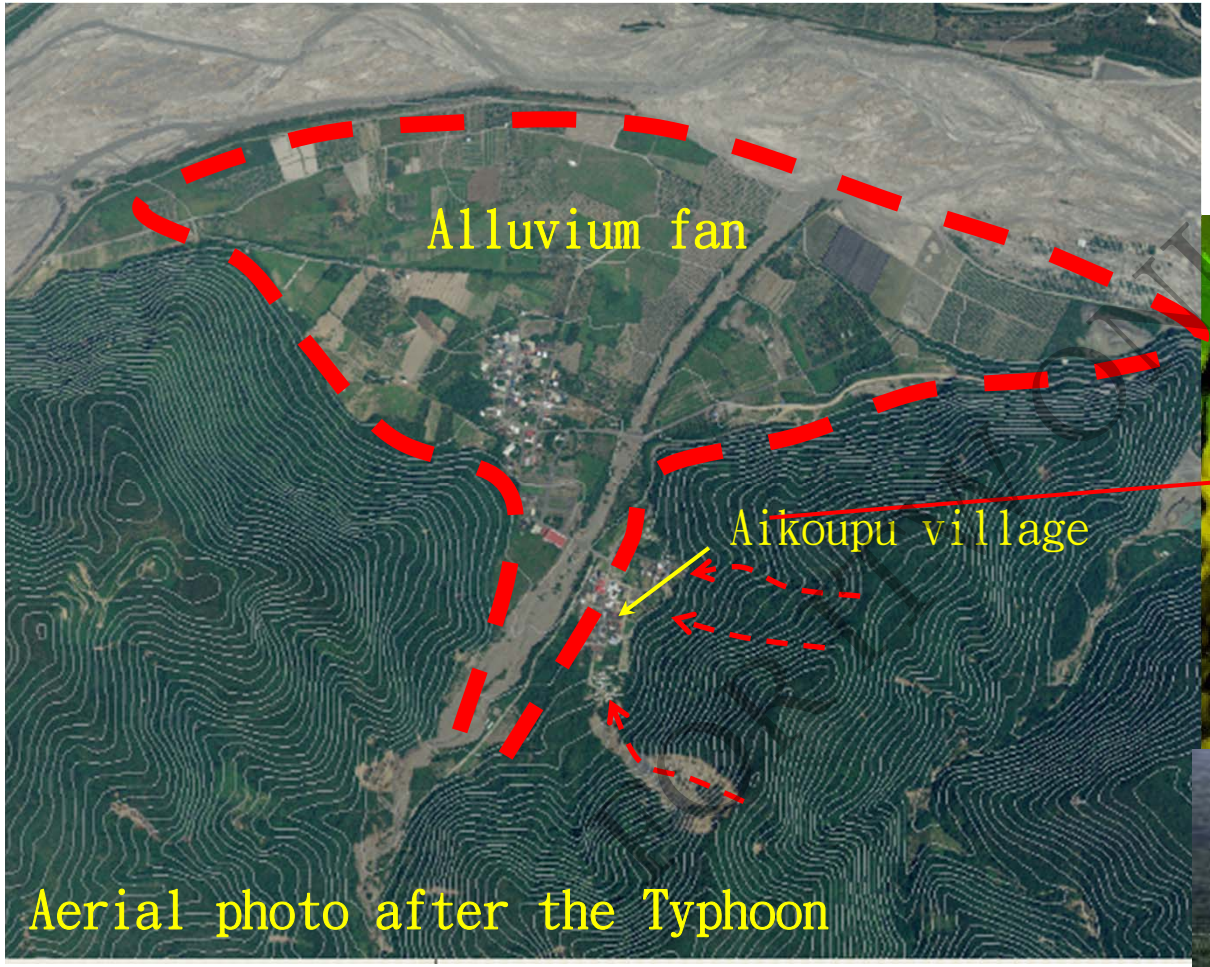
Villages close to large-area Landslide

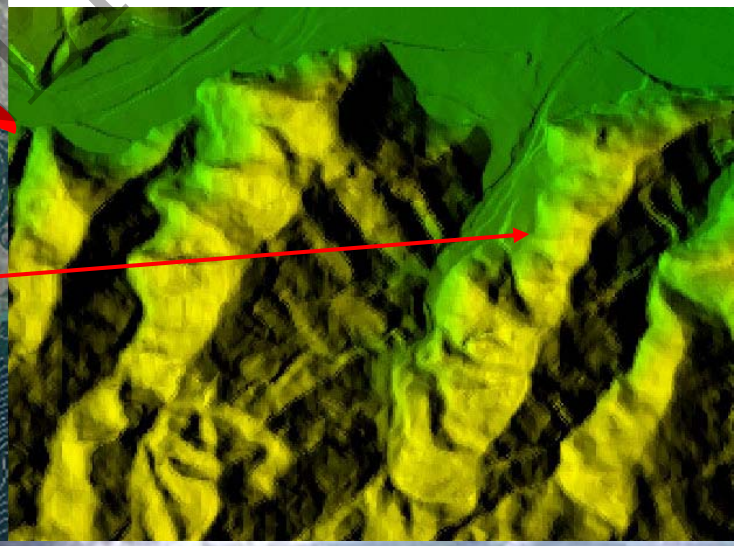


Villages threatened by the upstream sediment transport



Villages are not affected by large-area Landslide





Accumulated Rainfall in Typhoon Morakot:
1,200mm

GEOLOGIC INVESTIGATION & DATABASE CONSTRUCTION FOR THE UPSTREAM WATERSHED OF FLOOD-PRONE AREA

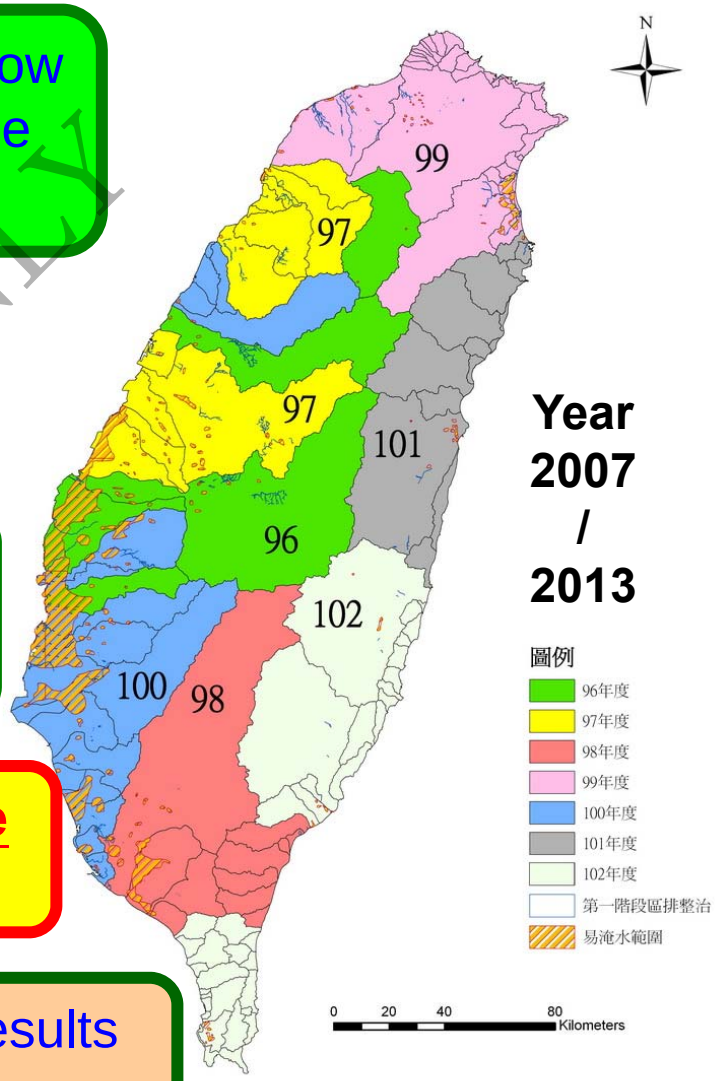
Geological Investigation, Landslide & Debris Flow Investigation and Susceptibility Evaluation in the Watershed Area

Investigation and Evaluation of Erosion and Sedimentation in the Watershed Area

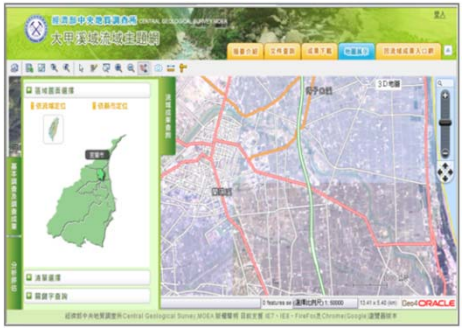
Investigation and Evaluation of the Effect of Hydrogeology on Slope Stability in the Watershed Area

Geomorphological and Geological Database Construction for the Watershed Area

Research on Application of the Investigation Results for the Upstream Watershed of Flood-Prone Areas



Database of the Geomorphological and Geological for the Watersheds Area (in Chinese)

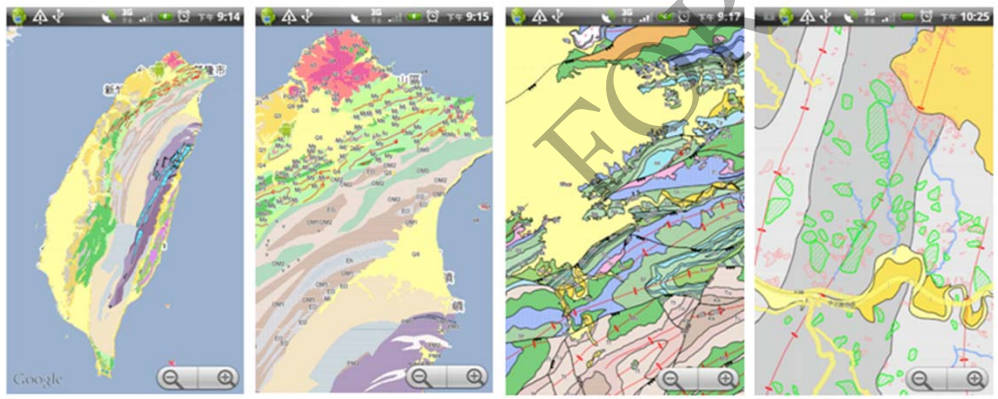


Page of river basin theme webs

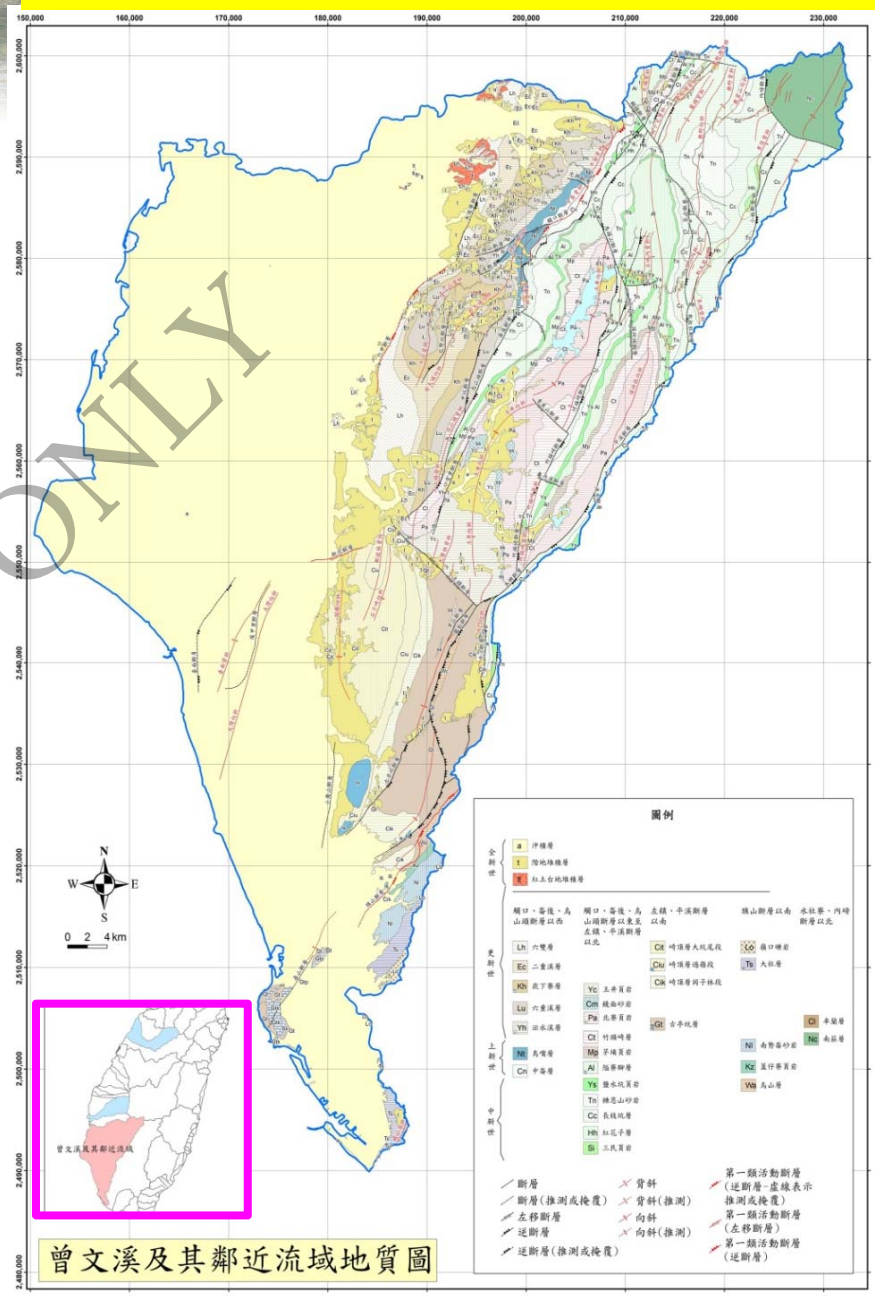
Page of web portal of river basin surveys

Zengwen River Watershed

Display of online geological maps using mobile devices

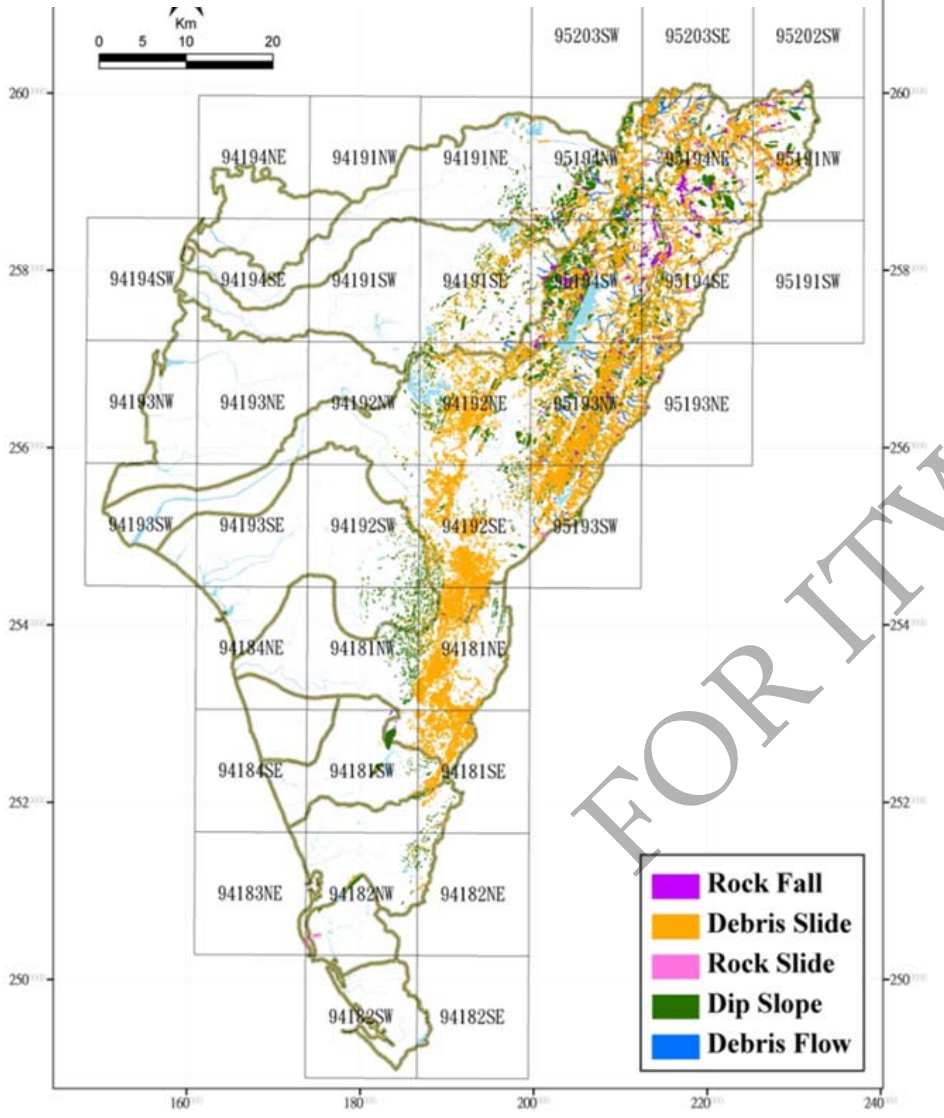


Display of SQLite offline thematic maps

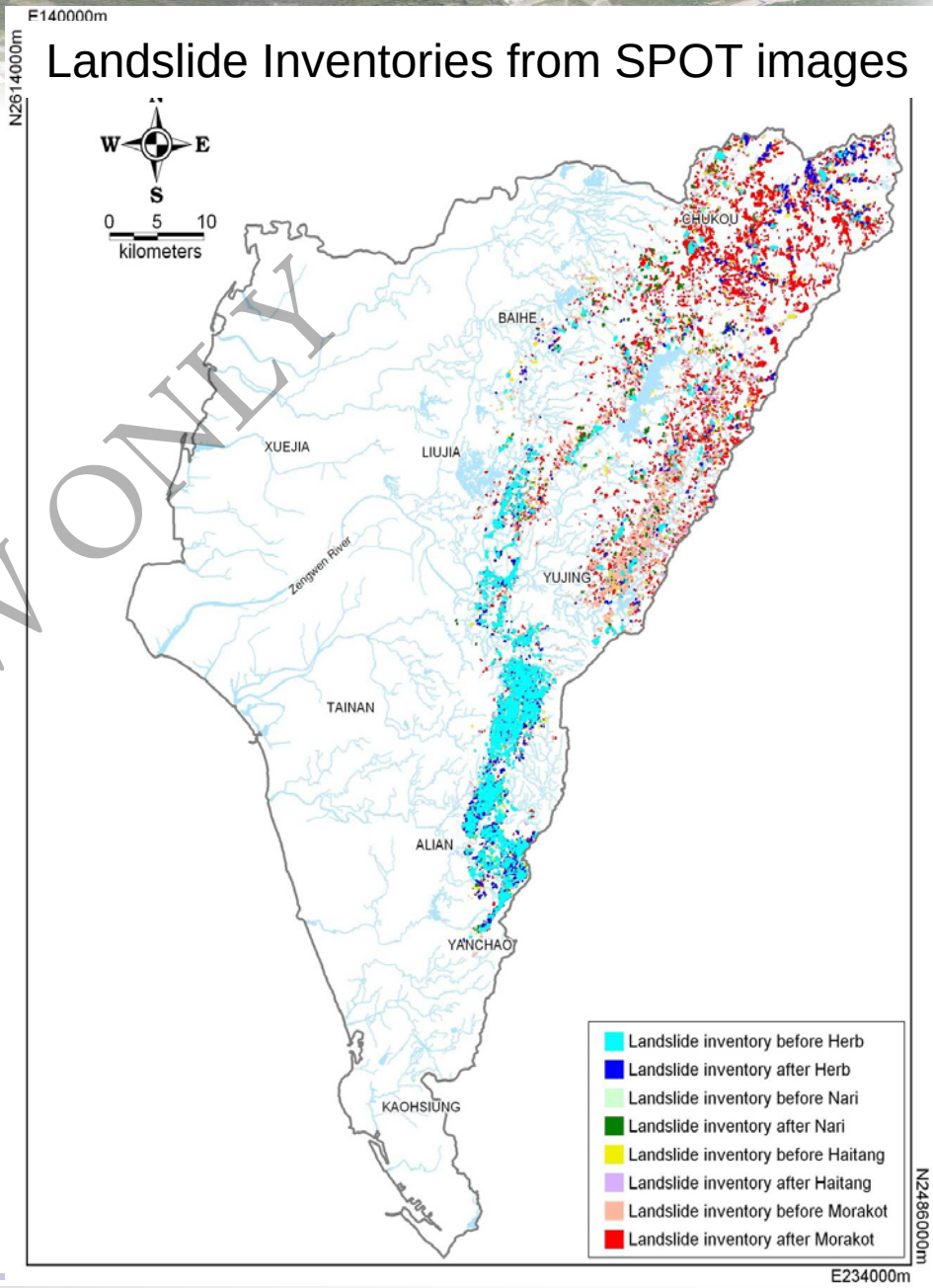


Zengwen River Watershed

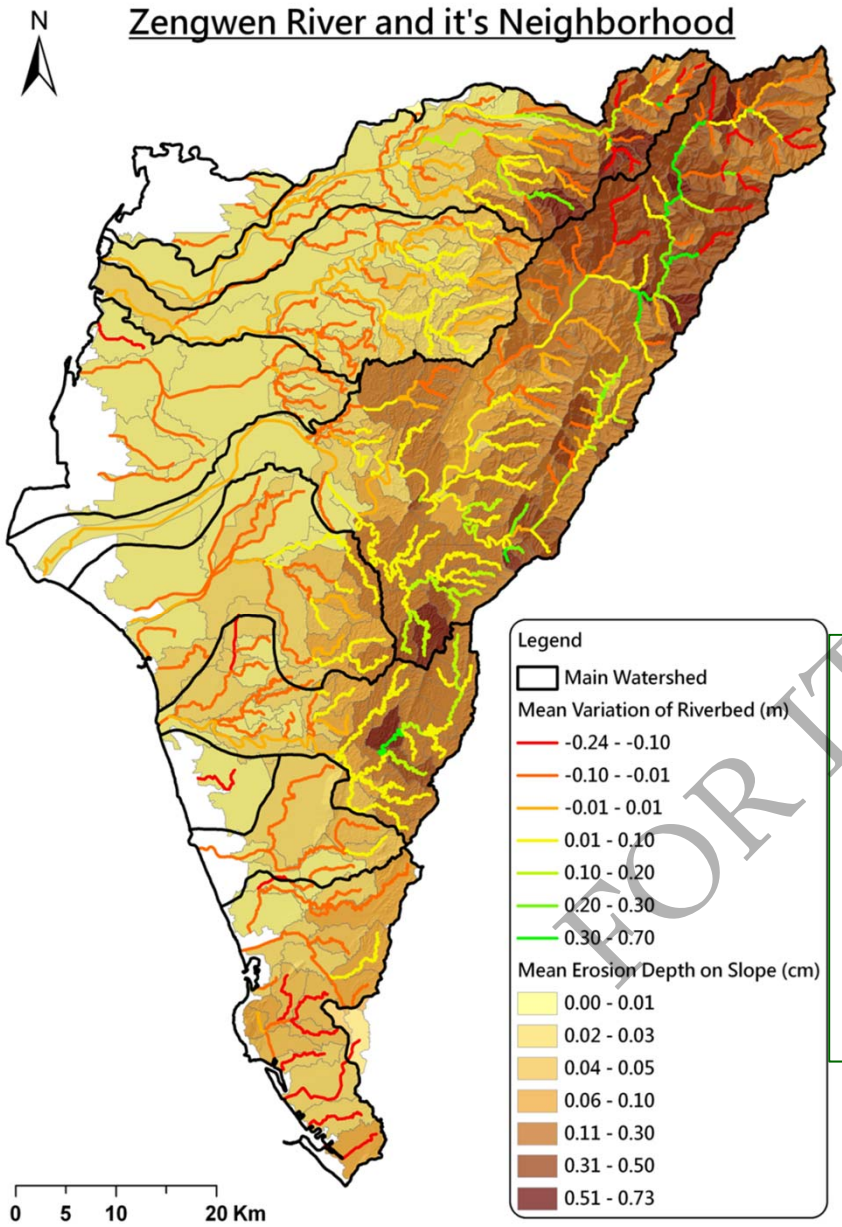
Landslide Inventory from aerial photo and field investigation



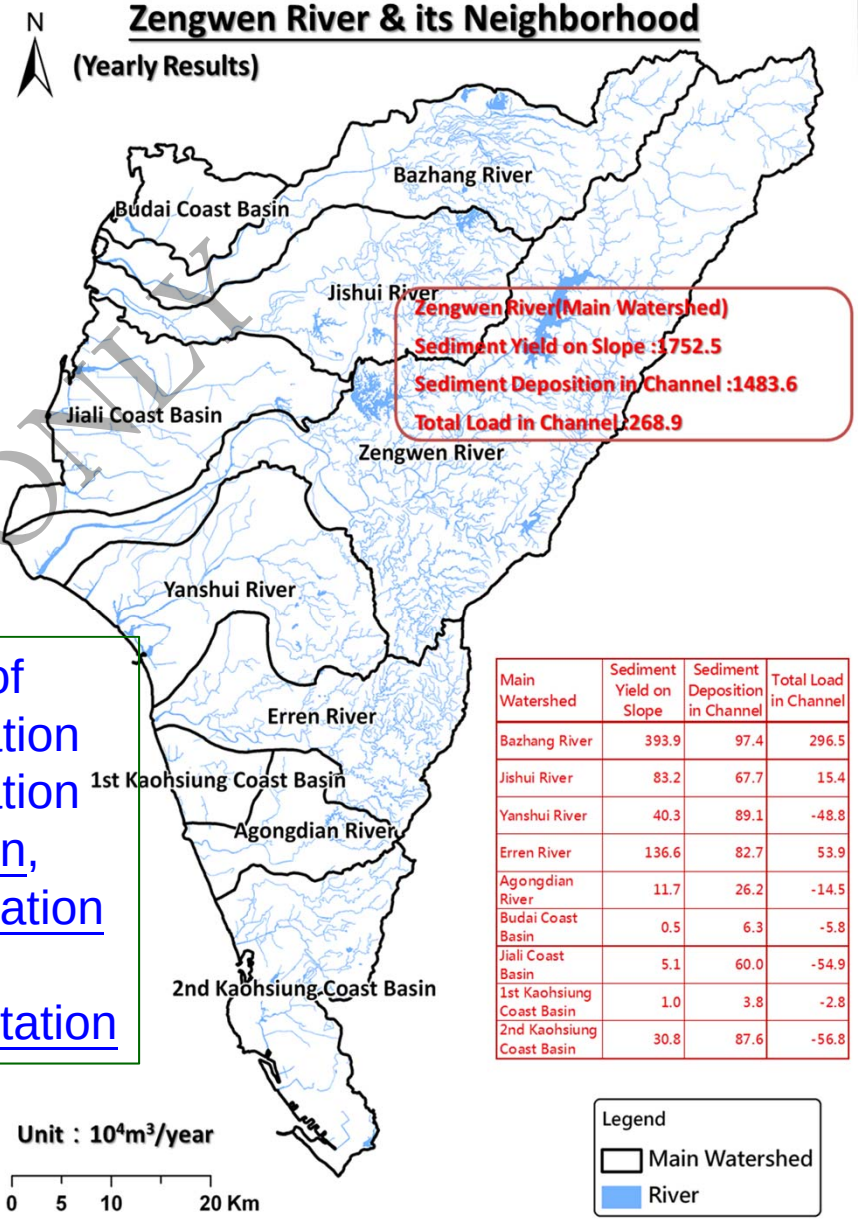
Landslide Inventories from SPOT images



Zengwen River Watershed



Results of Investigation & Evaluation of Erosion, transportation and Sedimentation



Main Watershed	Sediment Yield on Slope	Sediment Deposition in Channel	Total Load in Channel
Bazhang River	393.9	97.4	296.5
Jishui River	83.2	67.7	15.4
Yanshui River	40.3	89.1	-48.8
Erren River	136.6	82.7	53.9
Agongdian River	11.7	26.2	-14.5
Budai Coast Basin	0.5	6.3	-5.8
Jiali Coast Basin	5.1	60.0	-54.9
1st Kaohsiung Coast Basin	1.0	3.8	-2.8
2nd Kaohsiung Coast Basin	30.8	87.6	-56.8

Geology Act

Zoning of Landslide Geological Sensitive Areas

GEOLOGY ACT—Geological Sensitive areas

Article 3.

Definition 5. Natural hazards investigations: Refers to the geological surveys for the establishment of geologic disasters database, the assessment of potential hazards and their prevention.

Article 5.

The public should be notified by the central regulatory authority of areas with special geologic scenery, environment or potential hazards.

Article 6.

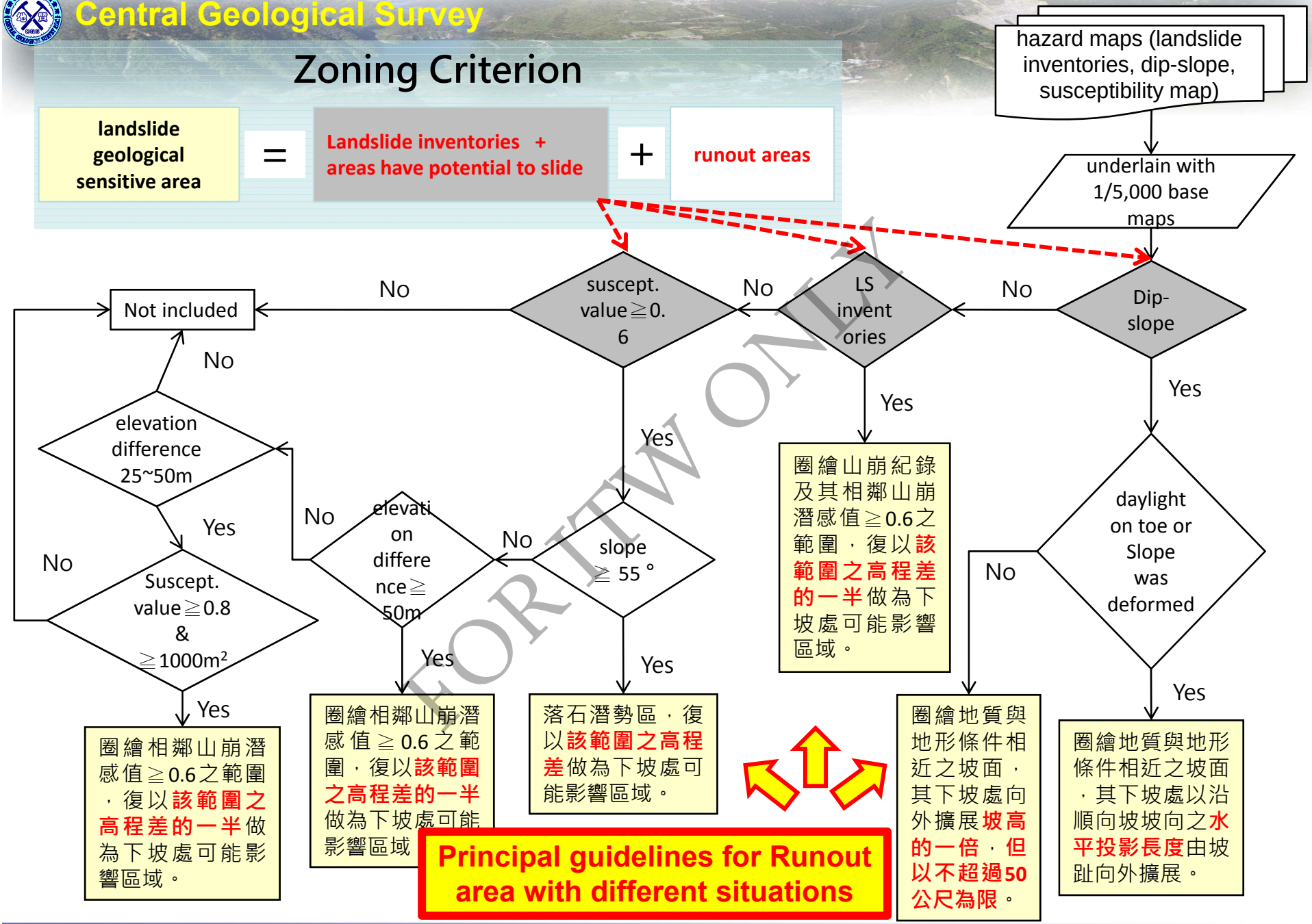
Each task-oriented regulatory authority should include the relevant data pertaining to geologically sensitive areas as reference for land utilization, land development assessment, hazard prevention and mitigation, environmental preservation and resources development.

Article 8.

Should a piece of land to be developed fall within a geologically sensitive region, it should first undergo a geologic site survey and safety assessment before filing an application for development. But this does not apply to emergency disaster plans.

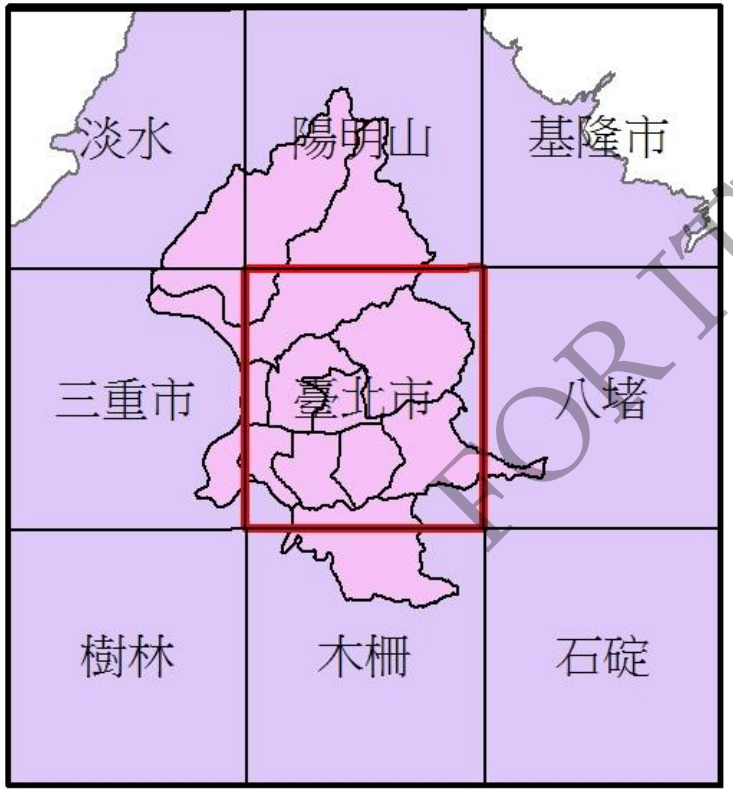
Zoning Criterion

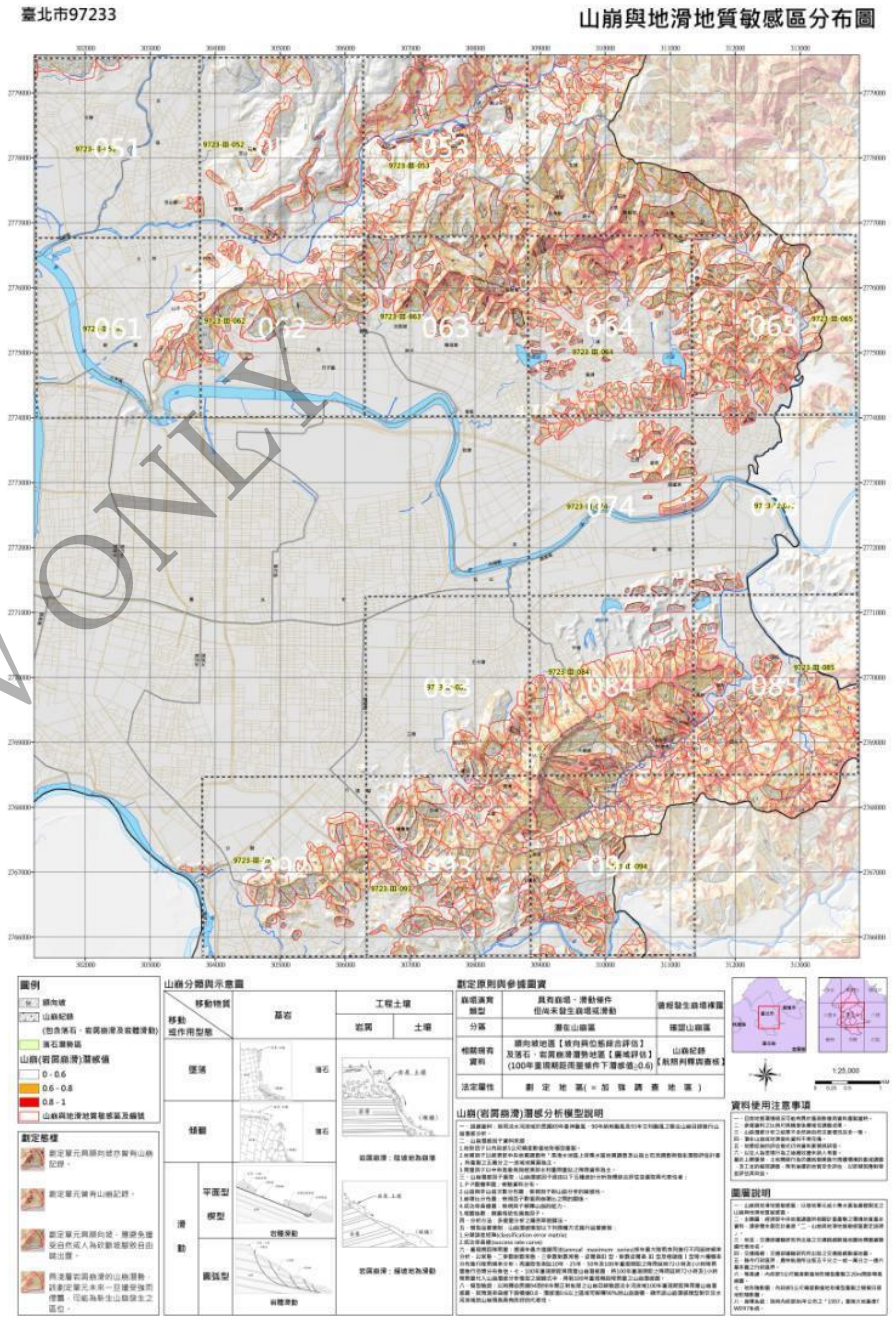
landslide geological sensitive area = **Landslide inventories + areas have potential to slide** + **runout areas**



Principal guidelines for Runout area with different situations

The primary results of Delineation the “Landslide Geological Sensitive Areas” in Taipei City





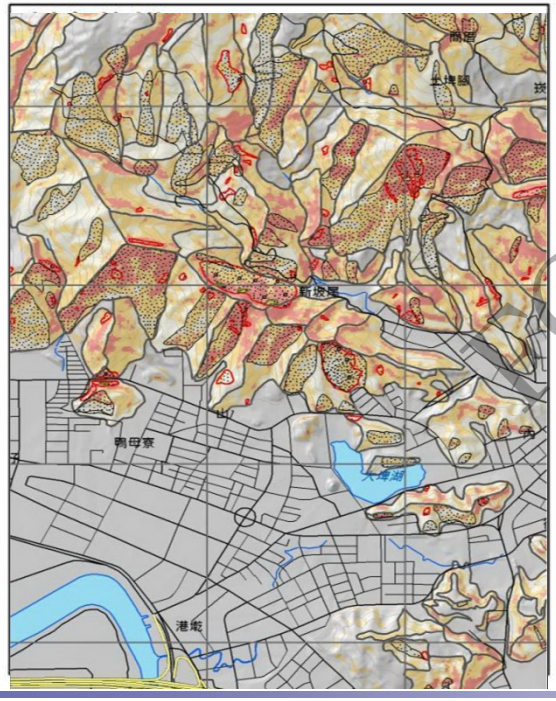
Legend & Descriptions

圖例

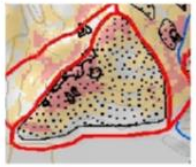
- 順向坡(Dip-slope)
- 山崩紀錄(Landslide Inventory)
  (包含落石、岩屑崩滑及岩體滑動)
- 落石潛勢區(Rock fall potential)

山崩(岩屑崩滑)潛感值(Susceptibility Index)

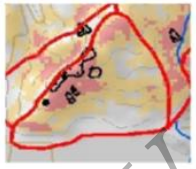
- 0 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 山崩與地滑地質敏感區及編號(areas & no.)



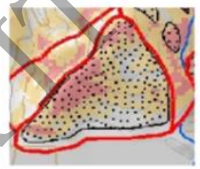
劃定態樣



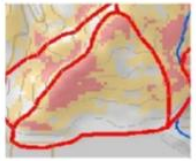
劃定單元具順向坡亦曾有山崩記錄。(Dip-slope & with landslide history)



劃定單元曾有山崩記錄。
(with landslide history)

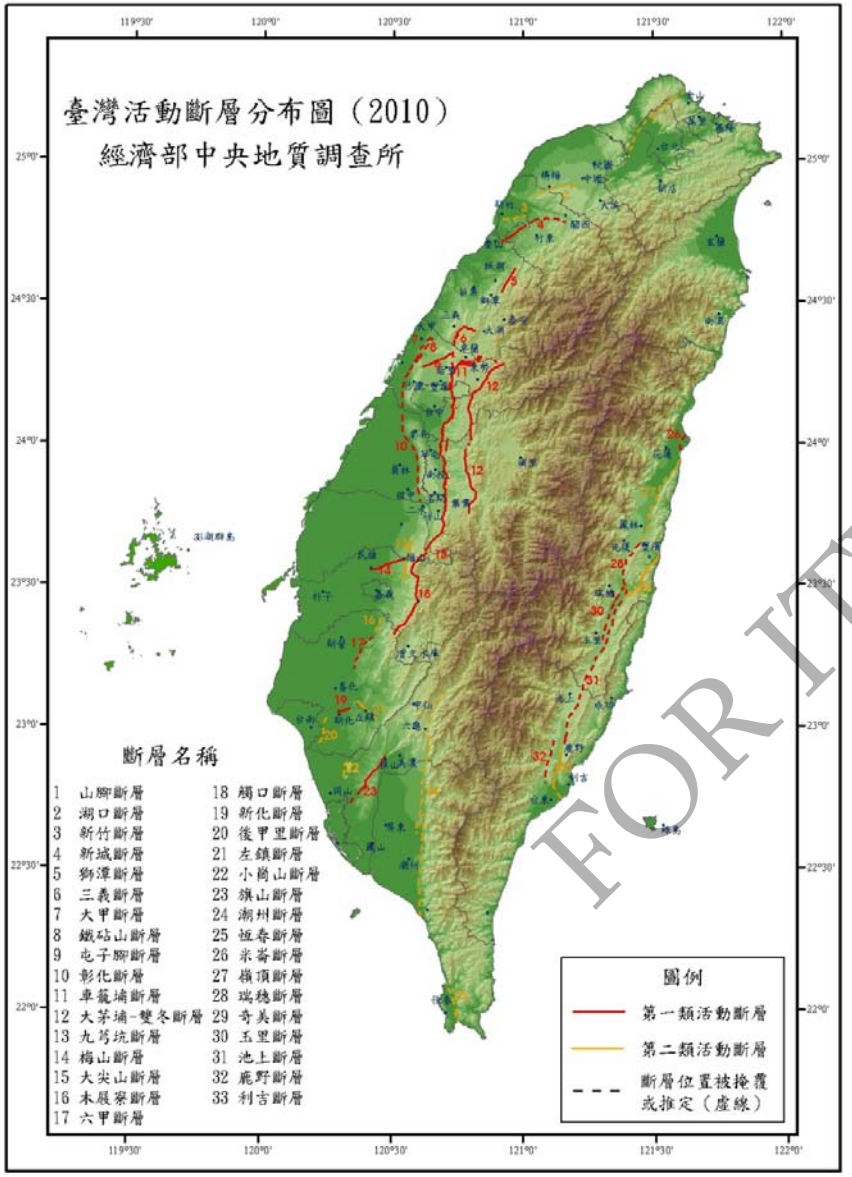


劃定單元具順向坡，應避免遭受自然或人為砍斷坡腳致自由端出露(Dip-slope, should avoid to cut the slope toe)



具淺層岩屑崩滑的山崩潛勢，該劃定單元未來一旦遭受強雨侵襲，可能為新生山崩發生之區位 (with slide potential during heavy rainfall)

Conclusions



CHALLENGES for Active Fault

- Enhancing Active Faults investigation
- Using PSInSAR image or LiDAR DEM to identify the topography of Active Structures
- Earthquake Rupture Forecast, Earthquake Probability, Return Period assessment
- Delineation the Active Fault Geological Sensitive Areas

CHALLENGES for Landslide

- Renewing the landslide Inventory every 5~10 years
- Using LiDAR DEM to identify the topography of deep-seated landslide(same type as Xiaolin Landslide)
- Developing new monitoring techniques for different types of landslide
- Delineation the Landslide Geological Sensitive Areas

謝謝(Hsieh Hsieh；thank you)；螃蟹(Paun Hsieh；crab)