

Efforts against Disasters' Root Causes through the Practice of TDA in Taiwan



Mr. Ting-Chi TSAO (TC21 member)
Principal Engineer & Group Chief
Disaster Prevention Technology Research Center
Sinotech Engineering Consultants, INC.
Taipei, Taiwan

Outline

I. Introduction

II. Resilience

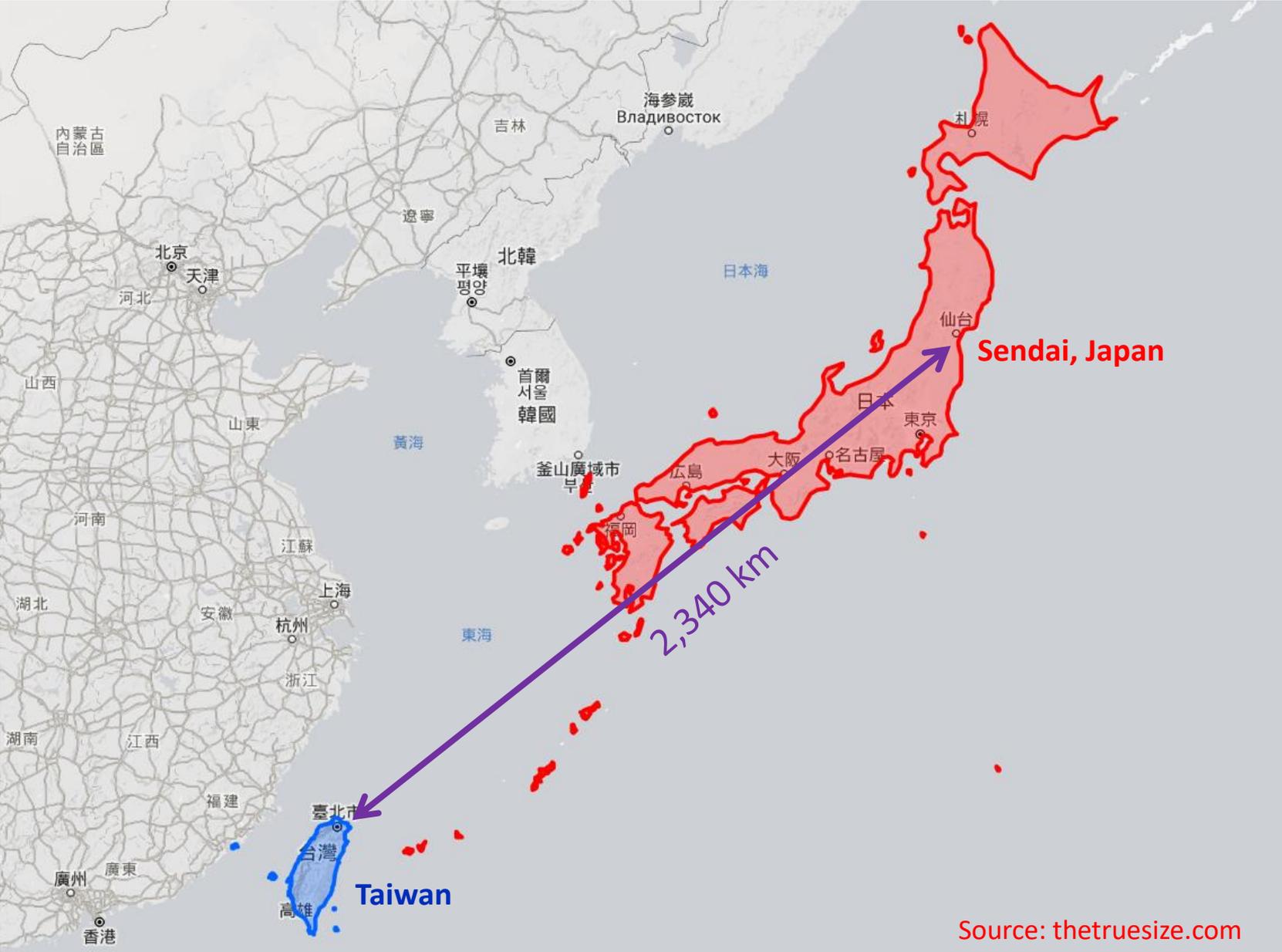
III. Typhoon Morakot & Xinshan Village

IV. Transdisciplinary Approach

V. Conclusion & Suggestions



Preface



Preface

Source: thetruesize.com
Wikipedia.org

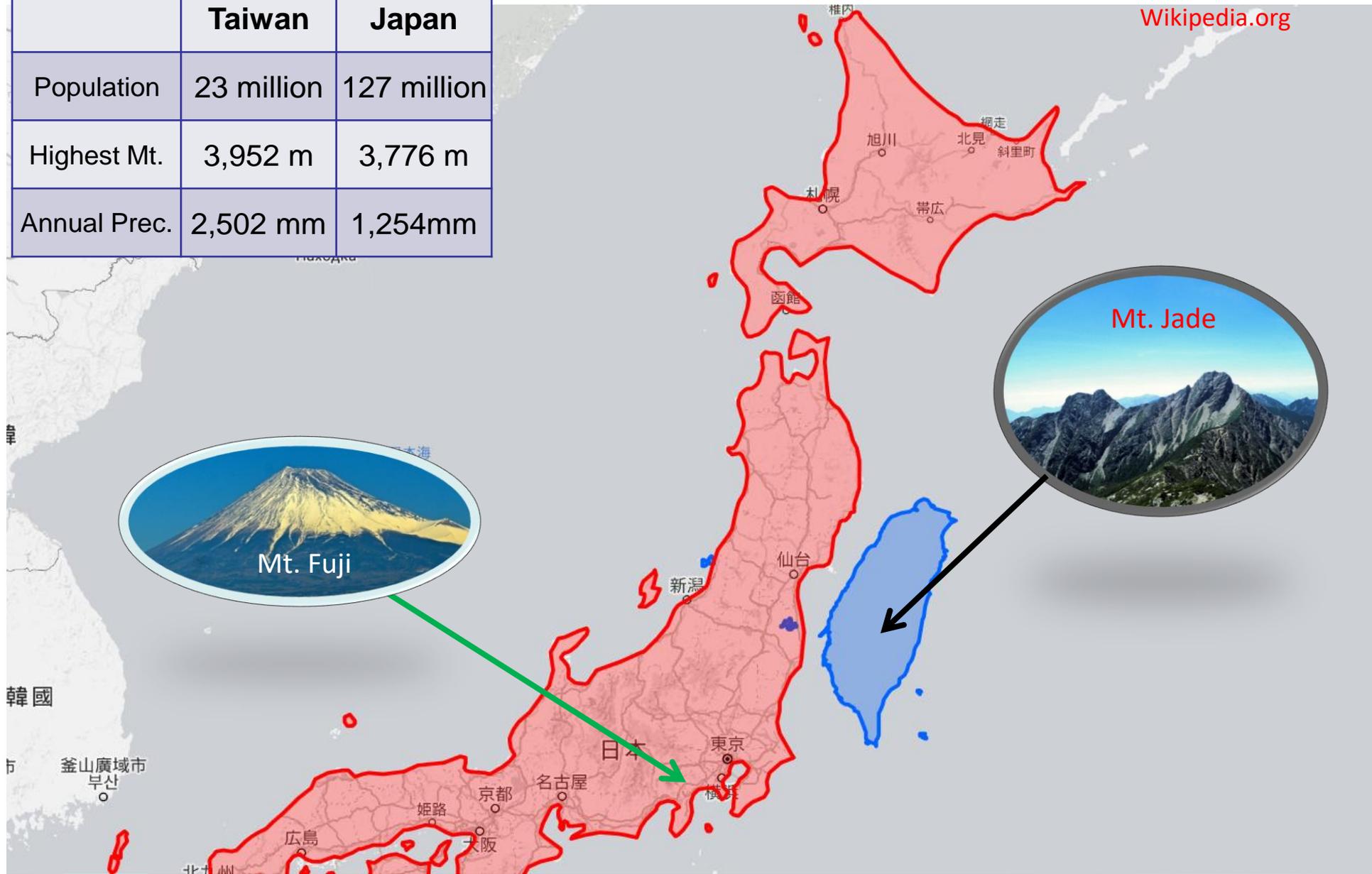
	Taiwan	Japan
Population	23 million	127 million
Highest Mt.	3,952 m	3,776 m
Annual Prec.	2,502 mm	1,254mm



Mt. Fuji

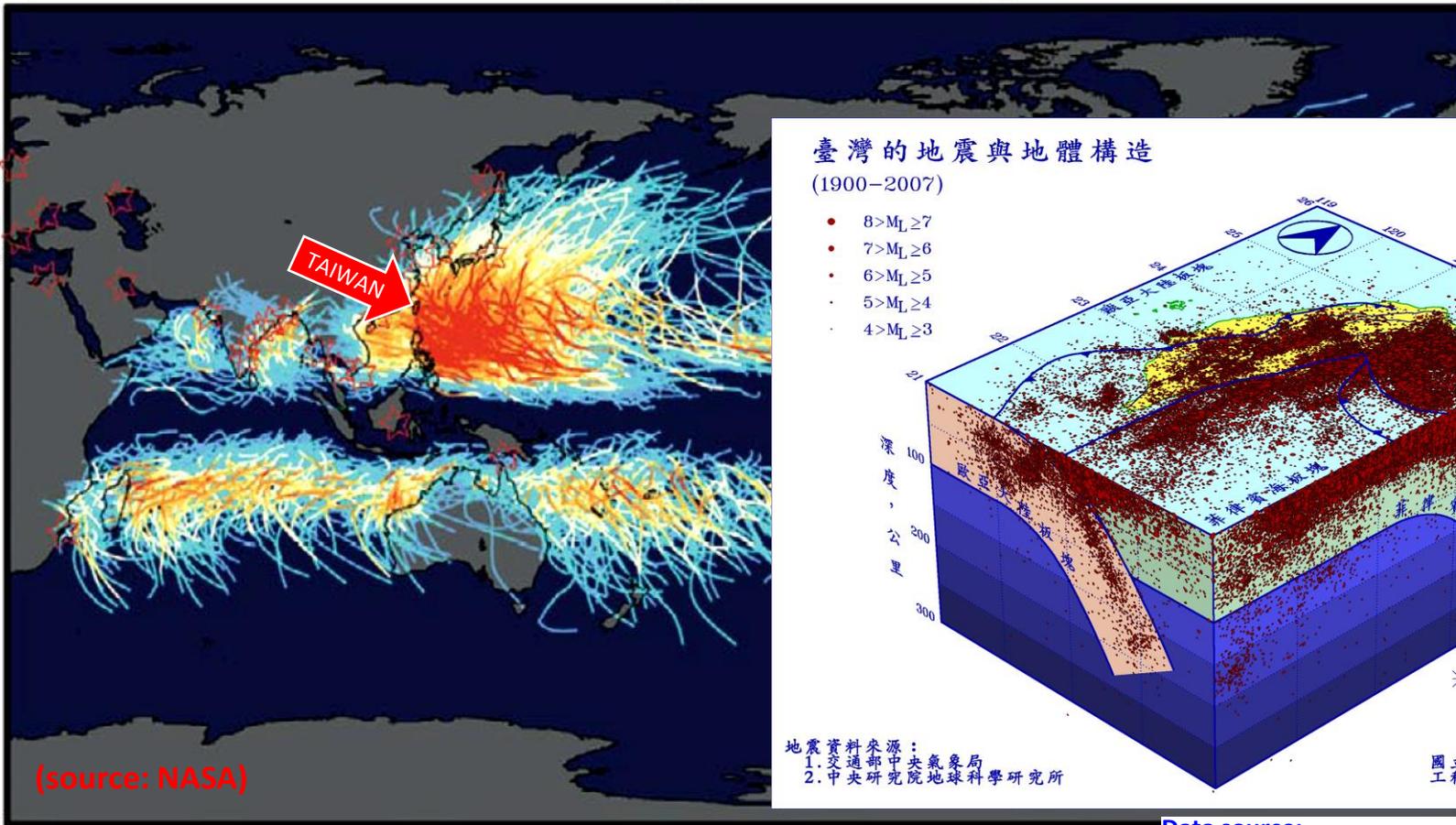


Mt. Jade



Introduction – a hazard prone region

Tracks and Intensity of All Tropical Storms

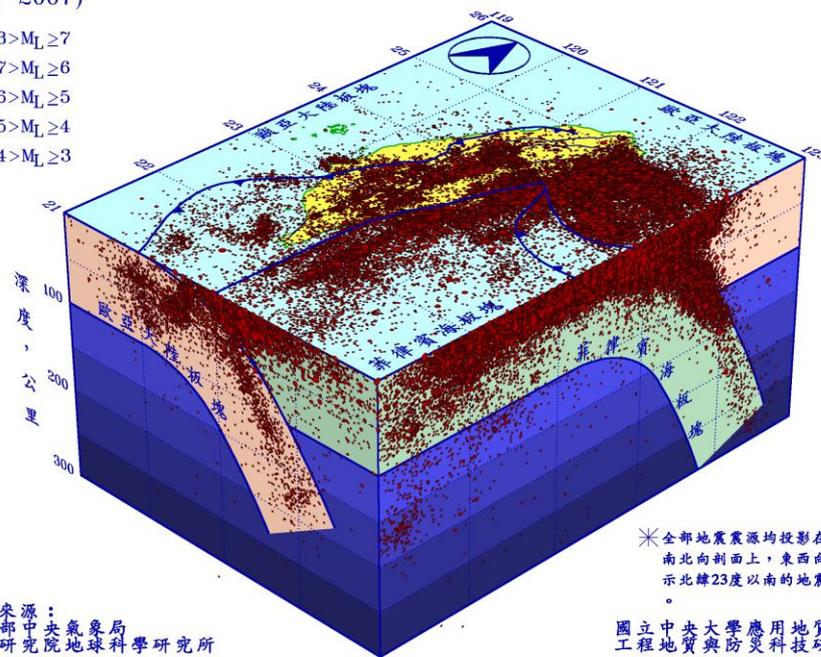


(source: NASA)

臺灣的地震與地體構造

(1900-2007)

- $8 > M_L \geq 7$
- $7 > M_L \geq 6$
- $6 > M_L \geq 5$
- $5 > M_L \geq 4$
- $4 > M_L \geq 3$



地震資料來源：
 1. 交通部中央氣象局
 2. 中央研究院地球科學研究所

* 全部地震震源均投影在水平面及南北向剖面上，東西向剖面僅表示北緯23度以南的地震震源投影。

國立中央大學應用地質研究所
 工程地質與防災科技研究室印製

Data source:

1. Central Weather Bureau (CWB)
2. Institute of Earth Sciences, Academia Sinica
3. National Central University



Saffir-Simpson Hurricane Intensity Scale

Taiwan Located in High-Risk Area of Natural Disaster



Typhoon

Natural Disaster NO.1

World Bank(2005) :

Land area & affected population are exposed to kinds or more natural disasters at the same time

3



Earthquake



Flood

Threat Up to >73%

Land area & affected population are exposed to kinds or more natural disasters at the same time

2



Mass Movement

Threat up to 90%



Resilience

$$\frac{\text{Hazard} \times \text{Vulnerability} \times \text{Exposure}}{\text{Resilience or coping capacities}} = \text{Disaster Risk}$$

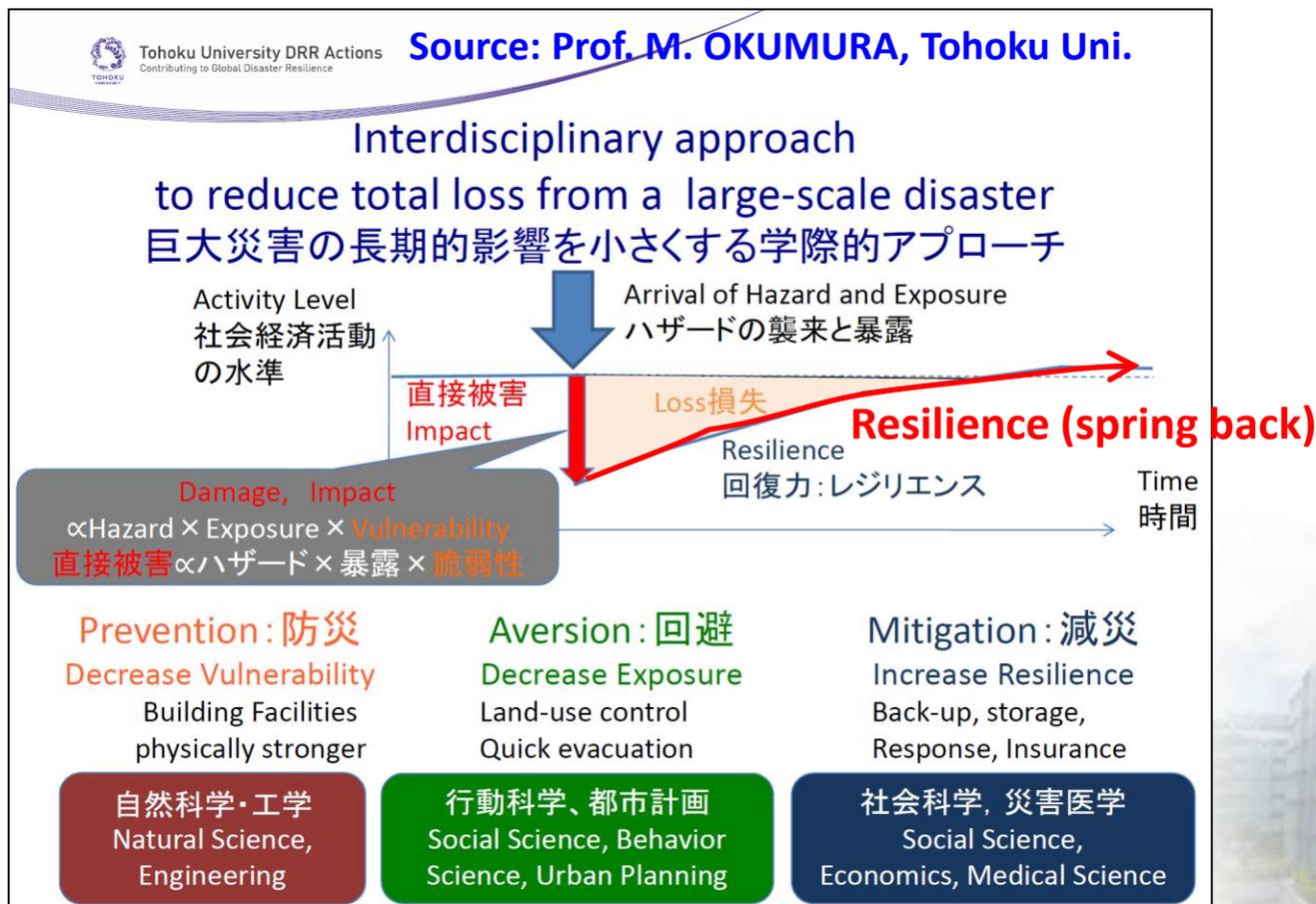
(UNISDR, 2012)

“Resilience” means the ability to “**resile from**” or “**spring back from**” a shock. (UNISDR, 2009)



Resilience

“**Resilience**” means the ability to “**resile from**” or “**spring back from**” a shock. (UNISDR, 2009)



Ten Essentials for Making Cities Resilient

“.....investing in resilience is an opportunity for sustainable development....” (UNISDR, 2017, How to Make Cities More Resilient Handbook)

Essential 1	Organize for disaster resilience
Essential 2	Identify, understand, and use current and future risk scenarios
Essential 3	Strengthen financial capacity for resilience
Essential 4	Pursue resilient urban development and design
Essential 5	Safeguard natural buffers to enhance the protective functions offered by natural ecosystems
Essential 6	Strengthen institutional capacity for resilience
Essential 7	Understand and strengthen societal capacity for resilience
Essential 8	Increase infrastructure resilience
Essential 9	Ensure effective preparedness and disaster response
Essential 10	Expedite recovery and build back better



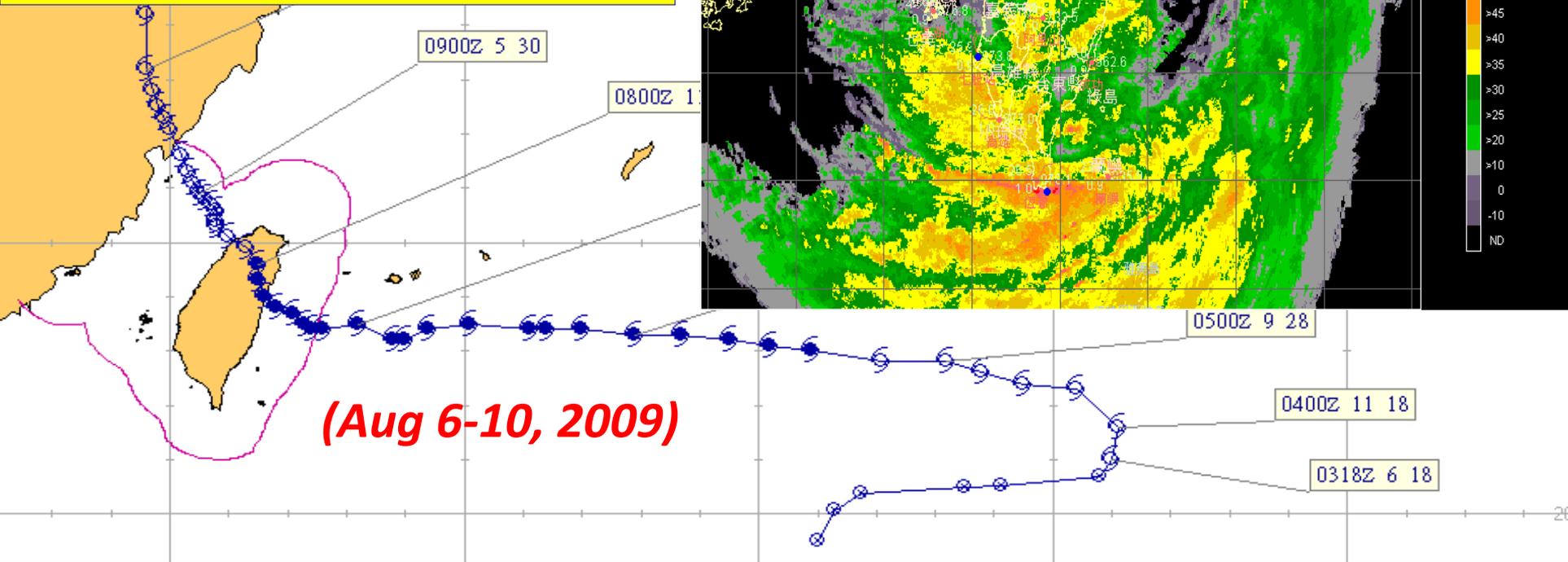
Typhoon Morakot, 2009

Typhoon Route and Radar Echo Image

Max. accumulated rainfall:
3059.5mm.

Total new landslides:
39,492 ha

Total damage: **3 billion USD, 0.67% GDP**



Typhoon Morakot - damages



Source: Chern, 2011



Xinshan Village – a hazard prone community

Population: 360 (Aug., 2009)

Hazard history: 1996 (Typhoon), 1999 (E.Q.),
2001 (Typhoon)



1996 Typhoon Herb



2001 Typhoon Toraji



2001 Typhoon Toraji

Vulnerable to hazard risk, but village head and residents have good risk awareness



Xinshan Village – a hazard prone community

5PM: Village head (Ms.Lin) received red warning from SWCB

2AM: Ms. Lin started to evacuate people

~3AM: 135 people evacuation complete

3AM: Buildings started to collapse into the river

21 buildings totally collapsed, 10 half-collapsed, 800-m mountainous highway washed away



Source: Apple Daily Times

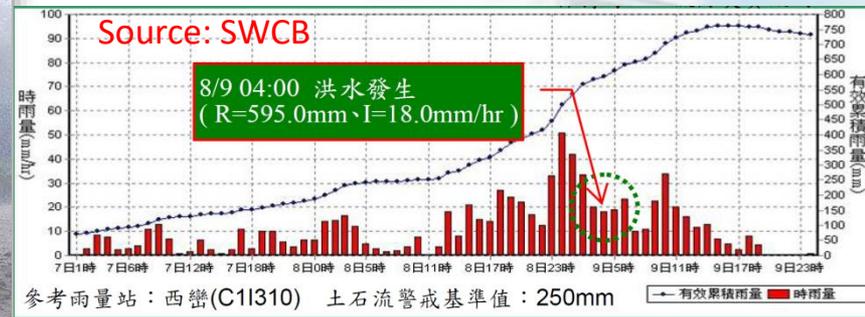


Source: Apple Daily Times

蘋果日報



蘋果日報



Xinshan Village – a miracle

Village head, **Ms. Lin**, together with other **33 volunteer specialists** received **medals** from the **President** due to their courageous act during Typhoon MORAKOT, which prevent the casualties of **2,000+ people**.



Source: CNA



Source: CNA

Now the residents of Xinshan Village had **relocated** to NGO donated permanent housings **6-km away**.



Xinshan Village – village head

參、村長選舉候選人

選舉區	號次	相片	姓名	出生	性別	出生地	推政黨	學歷	經歷	政見
新山村	1		林美玲	43年3月1日	女	臺灣省南投縣	無	臺灣省立南投高級商業職業學校畢業	一. 水里鄉新山村第16、17、18、19屆村長。 二. 榮獲內政部核定94年、101年度「特優村里長」。 三. 擔任行政院農業委員會水土保持局第3屆、4屆、5屆土石流防災專員。	一. 配合政府相關單位爭取村內各項建設。 二. 協助村民辦理各項社會福利申請補助。 三. 熟誠真心服務村民。

Ms. Lin:

1. Aged 55 (2009)
2. Commercial High School
3. Village head **since 1998** (3 terms to 2009, 6 terms now)
4. **Excellent** Village Head Award (Ministry of Interior, 2005)
5. Debris Flow Volunteer Specialist **since 2007**
6. Husband former head of local farmers' association



Xinshan Village – village head

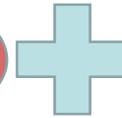
- ✓ “.....*'something looks abnormal'*, yesterday **2AM**, village head Ms. Lin and her husband looked at the un-rested heavy rain, which reminded them the situation in 1996 Typhoon Herb and 2001 Typhoon Toraji, both lead to severe damage in the village, so they decided to start calling people to evacuate.....”
(Liberty Times, Aug.10, 2009)
- ✓ Trained as volunteer specialist in 2007 (and 2009), Ms. Lin recalls that “..... *basic training is important, previously when raining we thought only the harvest of crops, now we think how many mm of rainfall would trigger a debris flow.....*”



Xinshan Village – Transdisciplinary approach

行政院
Executive Yuan

Legislation



Specialist
Training

逢甲大學
Feng Chia University



Where are
the dangers?

Hazard
mapping



When should
I evacuate?

Red warning
(threshold)



Who can help
me to
evacuate?

Evacuation
assist



Who can help
me to rebuild?

NGO
donation



Xinshan Village – Transdisciplinary approach

Legislation - *Disaster Prevention and Protection Act (2000)*

Since
2000

- Article 1: For making a sound **disaster prevention and protection system**, enhancing its functions, in order to protect the safety of people's lives, bodies, properties and conserve the homeland, the Act was enacted especially.
- ✦ Article 3: Prevention, response and recovery for all types of the disasters, the following **agencies shall be the central regulating authorities** for the disaster prevention and protection.
- ✦ Article 22: To reduce the occurrence or prevent further expansion of disaster, various tiers of governments depending on its functional authorities **shall implement following mitigation affairs.**



Xinshan Village – Transdisciplinary approach

Specialist Training *course prepared by university professors*

Since
2005

逢甲大學
Feng Chia University



**土石流防災徵英雄
士氣昂羊**

加入土石流防災專員，一同守護家園

報名資格	報名方式
1. 住在土石流潛勢溪流區之村屋居民 (村屋長或具備社區巡守隊員資格者佳)	傳真、電話報名或E-mail報名
2. 年滿18歲	聯絡人：王鴻源小姐、紀治宇先生
費用：免費！	電話：04-24617210分機3072、3045
	傳真：04-24616360
	E-mail：schuwang@gmail.com

*本課程由臺大完成課程訓練後，由水土保持局頒發結訓證書、證書及防災證書，並贈送防災保單保險。
*本課程由水土保持局主辦，水土保持局中區分區水土保持課及水土保持局第一分局協助辦理人員參與。

行政院農業委員會水土保持局

Volunteer specialist

Community education



Xinshan Village – Transdisciplinary approach

Hazard Mapping



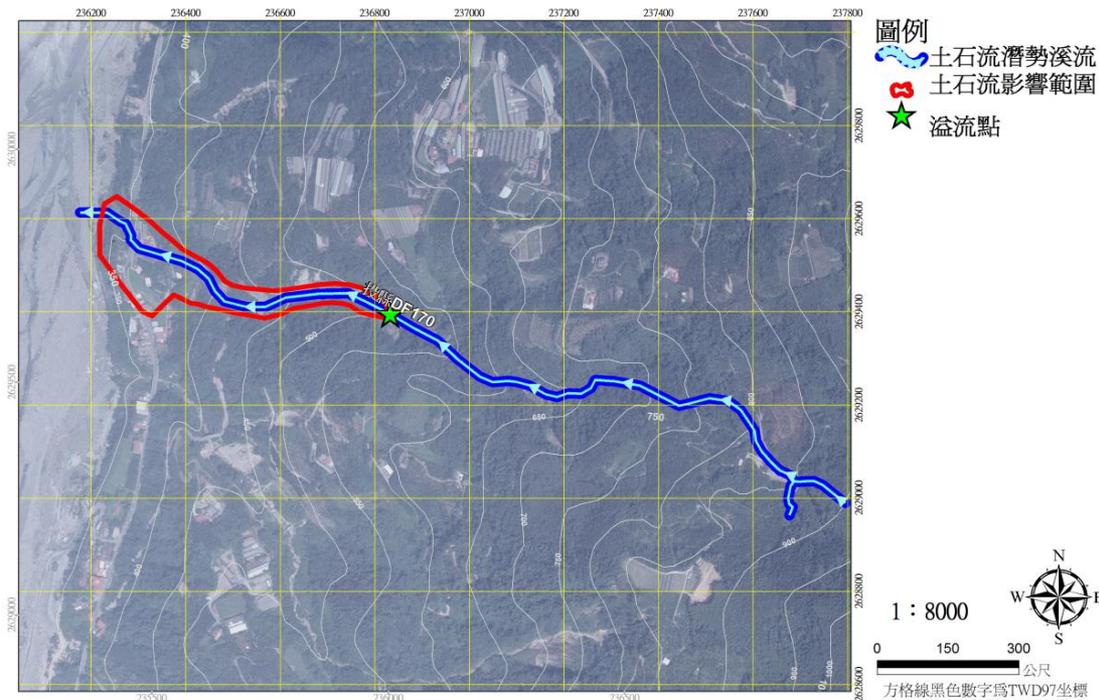
財團法人 中興工程顧問社
SINOTECH ENGINEERING CONSULTANTS, INC.



國立臺灣大學
National Taiwan University

Since
2003

Methodology and SOP developed by university professors, executed by engineers and geologists of consultant company (Sinotech).



投縣DF170土石流潛勢溪流位置圖



Xinshan Village – Transdisciplinary approach

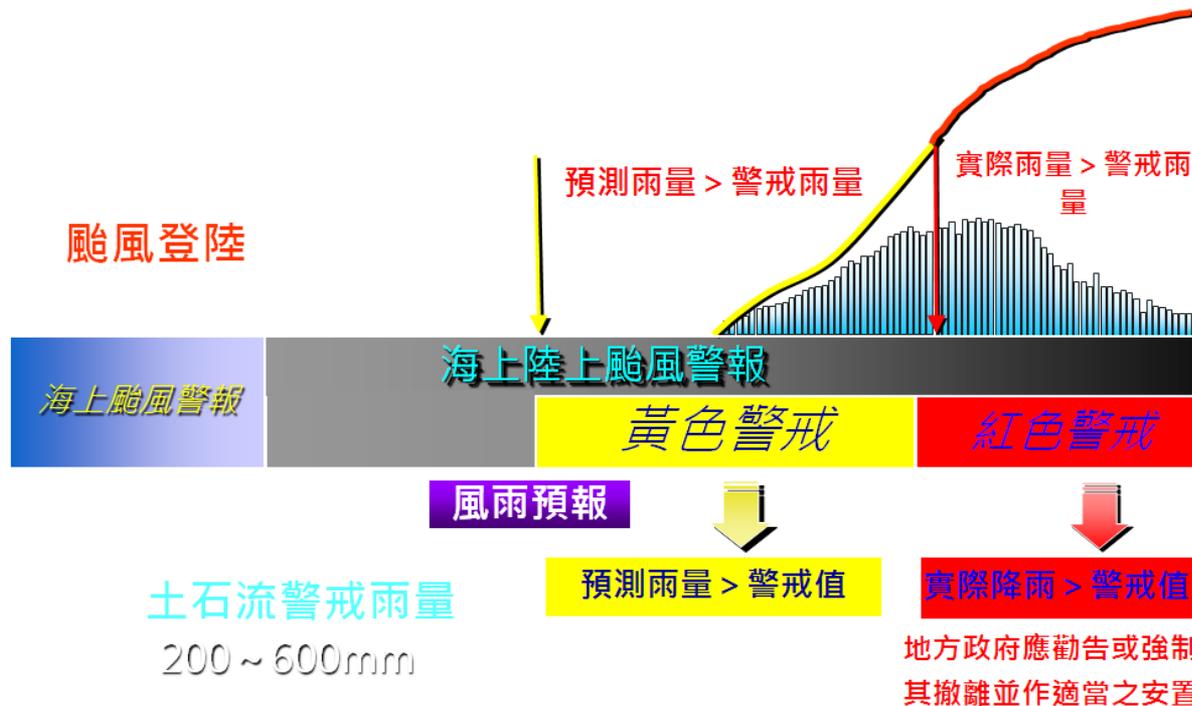
Red Warning



國立成功大學
National Cheng Kung University

Since
2005

Threshold developed by university professors,
red, yellow warning issued by the agency
(SWCB)



Xinshan Village – Transdisciplinary approach

Evacuation



內政部警政署
National Police Agency, Ministry



水里鄉公所
Shueili Township Office, Nantou County

Assisted by local policemen and military personnel, shelters prepared by local government.



Xinshan Village – Transdisciplinary approach

Relocation and Rebuild

財團法人張榮發基金會
CHANG YUNG-FA FOUNDATION

18 residential houses (1.6 million USD)
donated by NGO (Chang Yung-Fa Foundation)



Xinshan Village – Transdisciplinary approach

Central
Government

NGO

University
Professors

Police and Military

Engineer &
Geologist

Local
Government



Xinshan Village – a resilience community

Resilience Community Check List (UNISDR, 2017)

✓	Essential 1	Organize for disaster resilience
✓	Essential 2	Identify, understand, and use current and future risk scenarios
	Essential 3	Strengthen financial capacity for resilience
	Essential 4	Pursue resilient urban development and design
	Essential 5	Safeguard natural buffers to enhance the protective functions offered by natural ecosystems
✓	Essential 6	Strengthen institutional capacity for resilience
✓	Essential 7	Understand and strengthen societal capacity for resilience
	Essential 8	Increase infrastructure resilience
✓	Essential 9	Ensure effective preparedness and disaster response
✓	Essential 10	Expedite recovery and build back better



Conclusion & Suggestion

- ✓ **Transdisciplinary approach** (TDA) is the key to the success of Xinshan village example. Government agency, local government, university professors, engineers, policemen, local residents, NGO, were all involved.
- ✓ The knowledge flow of **being resilience** could and should be transformed to individuals, for the **individuals** are those who would “**resile from**” and “**spring back from**” a disaster





Mr. Ting-Chi TSAO

Disaster Prevention Technology Research Center
Sinotech Engineering Consultants, INC., Taiwan

tctsao@sinotech.org.tw

<http://dptrc.sinotech.org.tw>



財團法人 中興工程顧問社

SINOTECH ENGINEERING CONSULTANTS, INC.