



# Taiwan's Response Action to Flood Prevention

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Water Resources Agency, Ministry of Economic Affairs



# Outline

**I. Preface**

**II. Flood Protection Strategies**

**III. Disaster Prevention and Relief System**

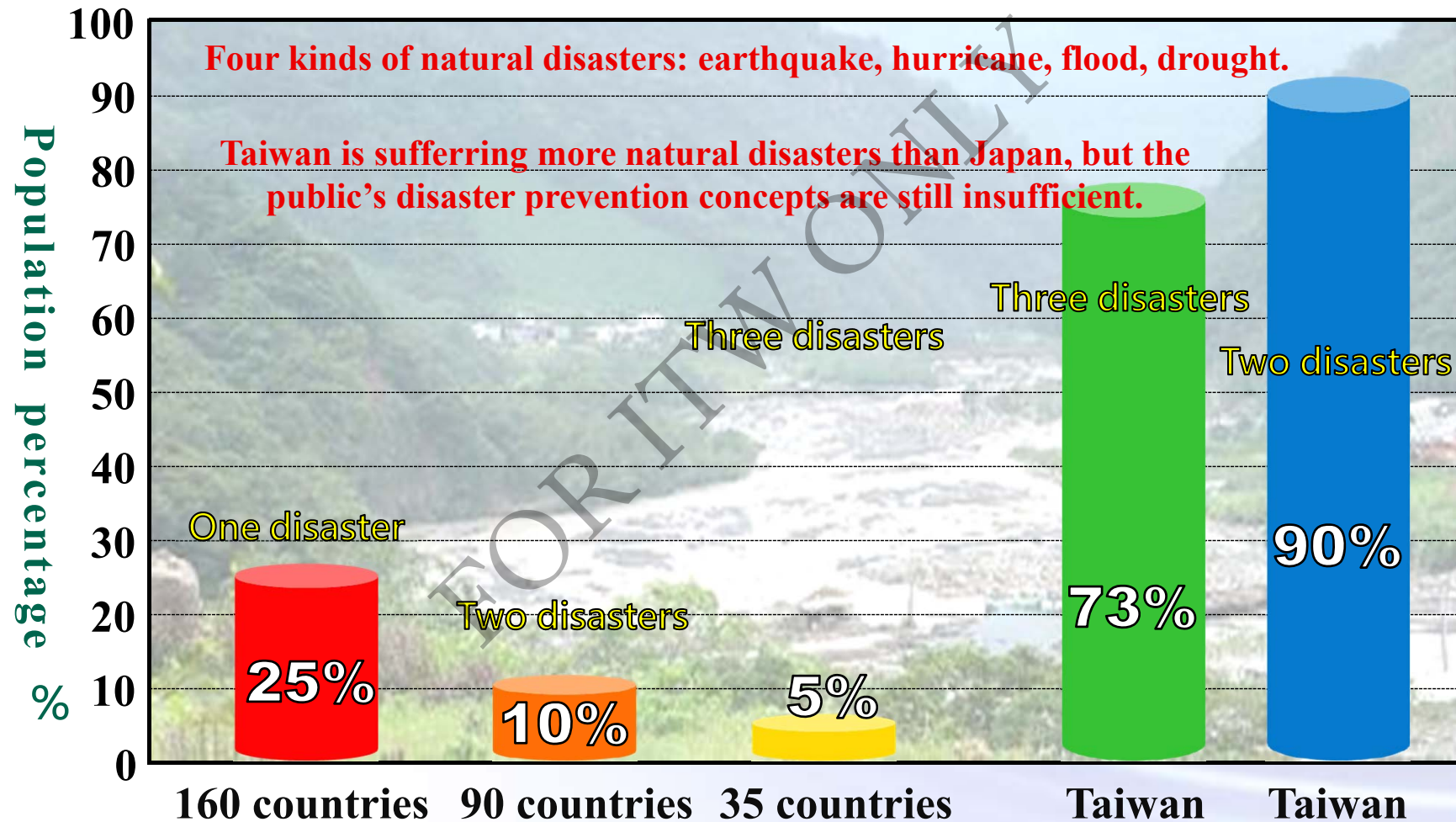
**IV. Response Action to Flood Prevention**

**V. Conclusion**



Taiwan is in the area threatened most severely by natural disasters.

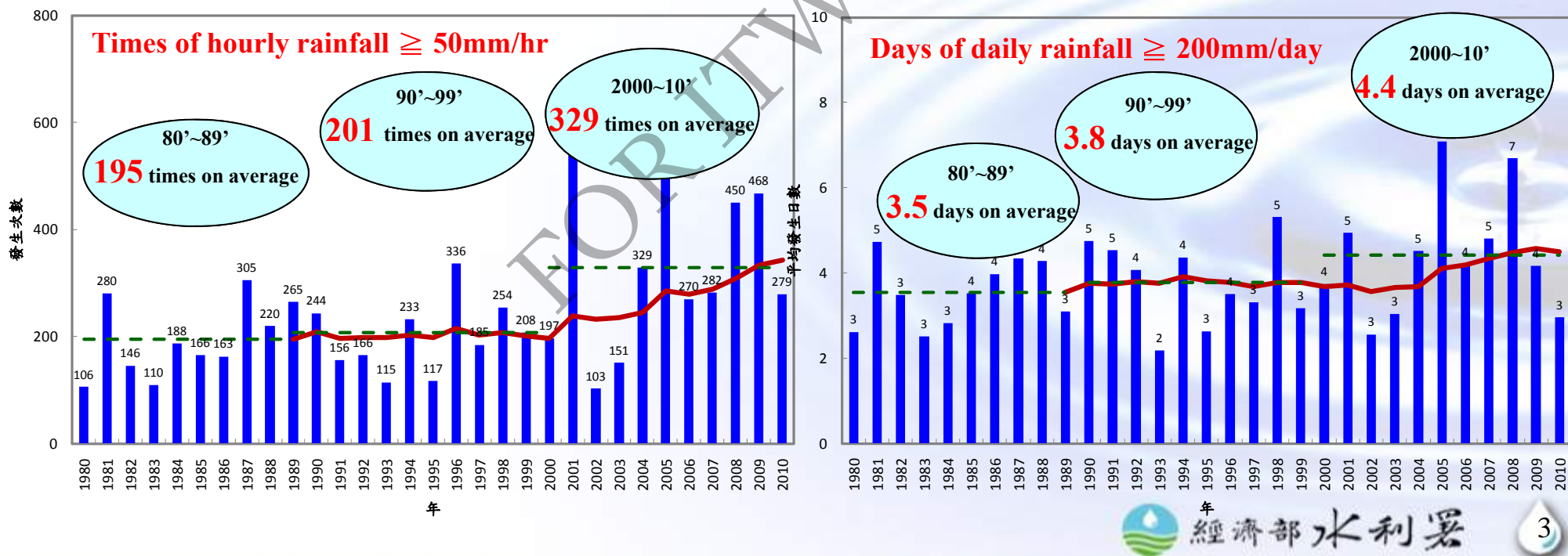
More than 90% of the population is threatened by two types of disasters.



The World Bank Report (2005): National Disaster Hotspots – A Global Risk Analysis

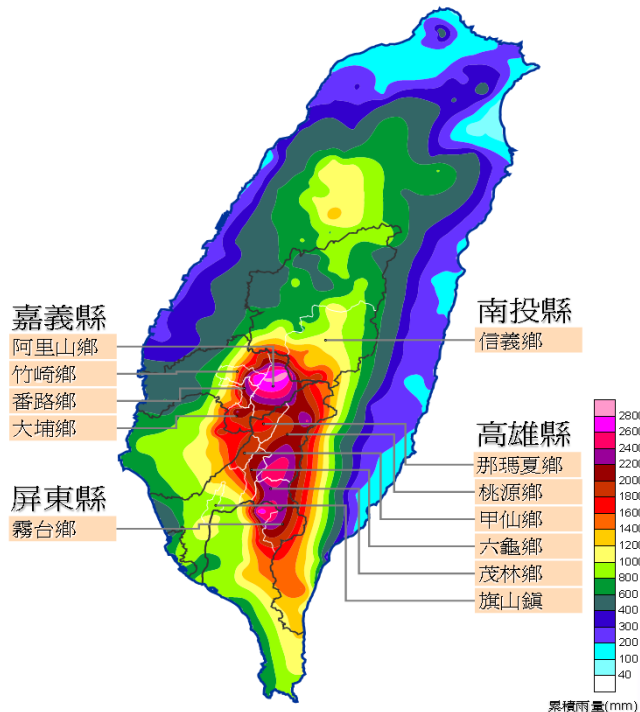
Analysis from 1980-2011 of 148 rainfall stations across Taiwan, with 10 years as a time interval, shows:

- Hourly rainfall  $\geq 50\text{mm/hr}$ , times of occurrence increased by 130 times compared to 20 years ago (increased to 329 times a year in the past 11 years).
- Daily rainfall  $\geq 200\text{mm/day}$ , days increased by 0.9 days a year compared to 20 years ago (averaging 4.4 days a year in the past 11 years).

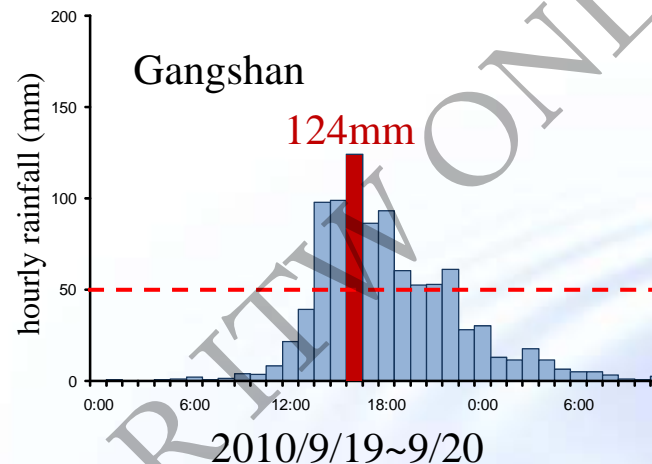


# Historical rainfall records in recent years

## 2009 Typhoon Morakot



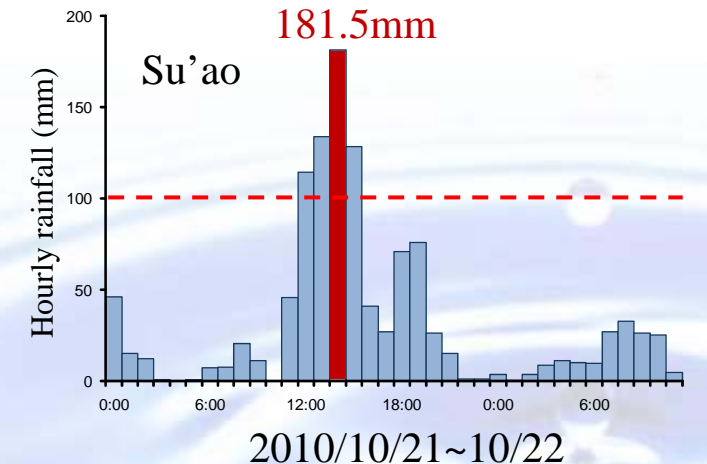
## 2010 Typhoon Fanapi



### Typhoon Fanapi rainfall characteristics

- Gangshan station: Exceeded 50mm/hr. for 9 consecutive hours, reaching 124mm/hr.; Zuoying Station: Exceeded 30mm/hr. for 9 consecutive hours

## 2010 Typhoon Megi



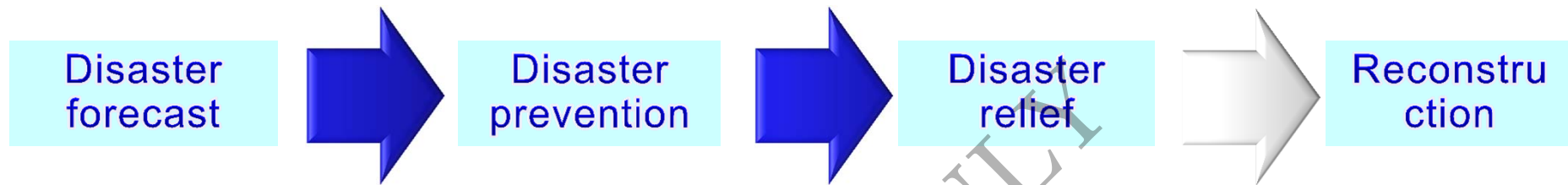
### Typhoon Megi rainfall characteristics

- Su'ao station: Exceeded 100mm/hr. for four consecutive hours, reaching 181.5mm/hr., 21 days cumulative rainfall reached 939.5mm (New record in the station)

### Typhoon Morakot rainfall characteristics

- Lasted a long time, high intensity, covered large areas
- Xinmajia, Taiwu (1) exceeded 50mm/hr. for 24 consecutive hours.
- Maximum cumulative rainfall of 2,884mm

Change the concept of disaster prevention, **actively prevent disasters** instead of providing relief for them afterwards.



◆ **Disaster forecast prior to disaster prevention**

- ◆ Climate is changing all the time → Estimate the disaster broadly, and seriously defend against the disaster
- ◆ Disasters are unpredictable → Zero casualties in floods → Preventive evacuation

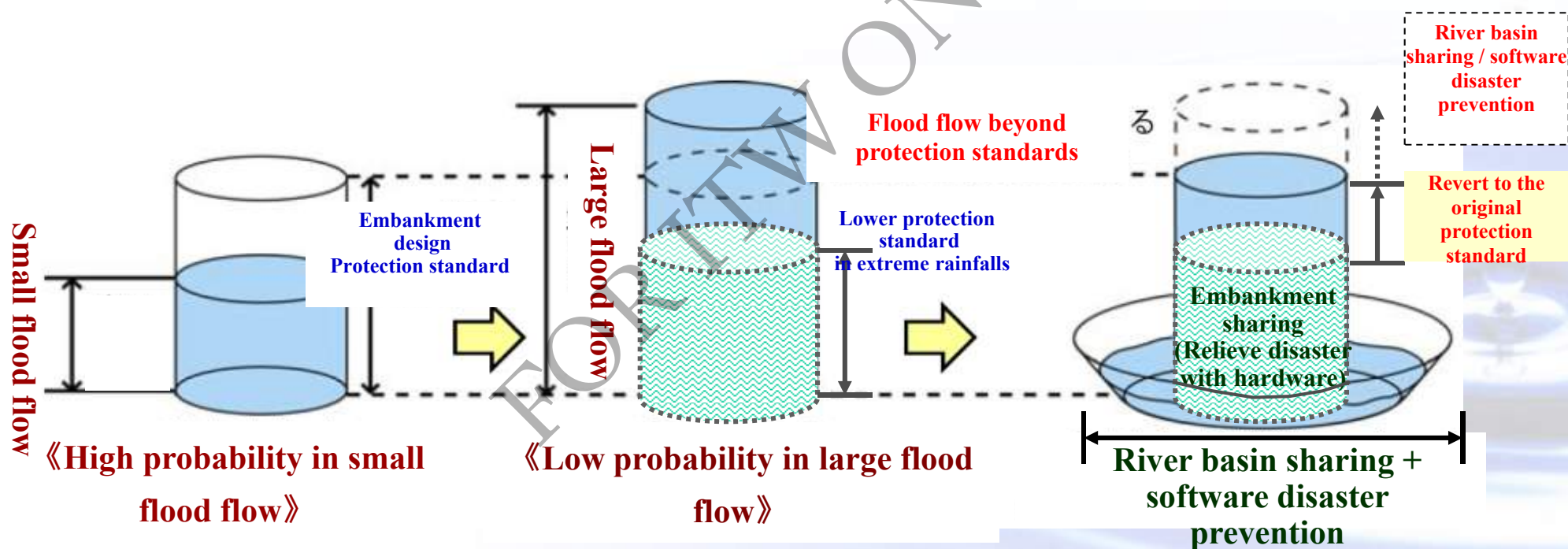
◆ **Disaster prevention prior to disaster relief and reconstruction**

- ◆ Comprehensively prepare for disaster prevention → Relieve disaster degree and losses  
→ Reduce works of disaster relief and reconstruction

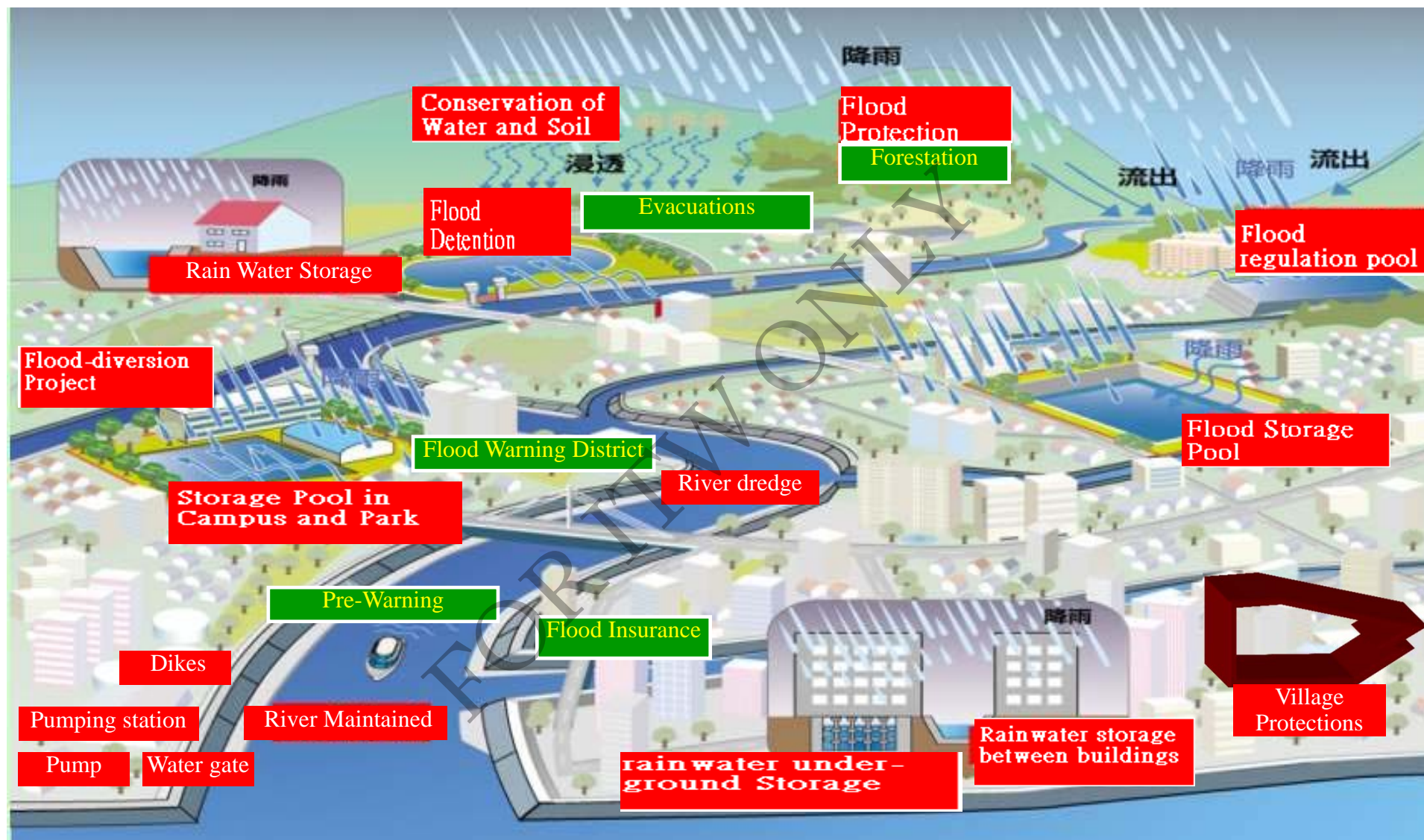
## II. Flood protection strategies

### Taiwan flood protection strategies – Promote comprehensive water control

- **Structural** - Do not fight against nature, ensure and strengthen the function of existing facilities, reduce flood potential.
- **Nonstructural** - coexist with water, restrict the development of sensitive areas in homeland planning.
  - coexist with disasters, conduct comprehensive water conservation along river basins and jointly share the flood.
  - Strengthen the preparation of disaster prevention and response measures, achieving the objective of “Zero casualties, less damage”.



(Revised from the local regeneration strategy in Japan, 2008)



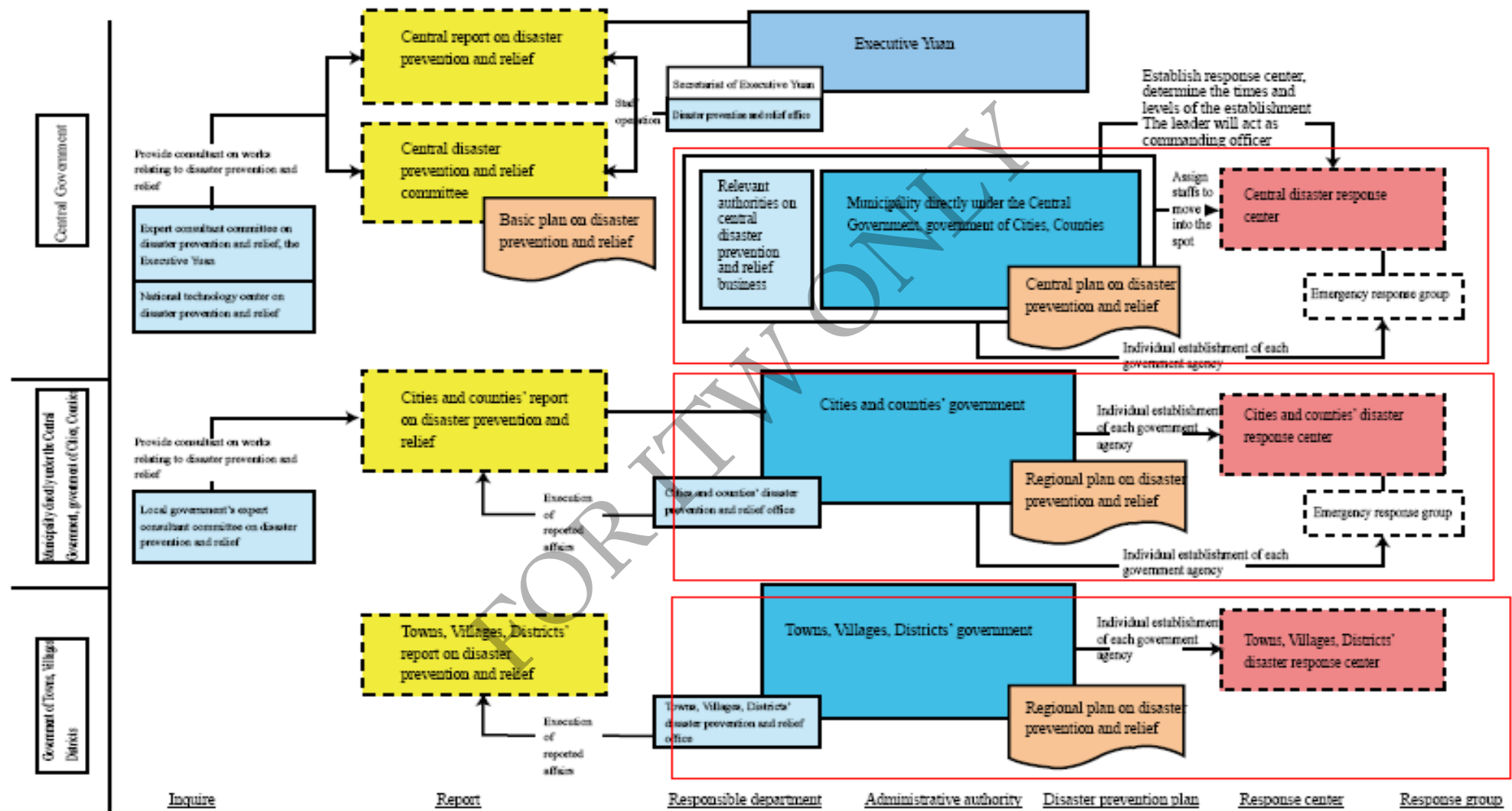
Structural  
Hydraulic Facilities

Nonstructural  
Non-hydraulic Facilities



### III. Disaster Prevention and Relief System

#### Taiwan Disaster Prevention and Relief System (in three levels)

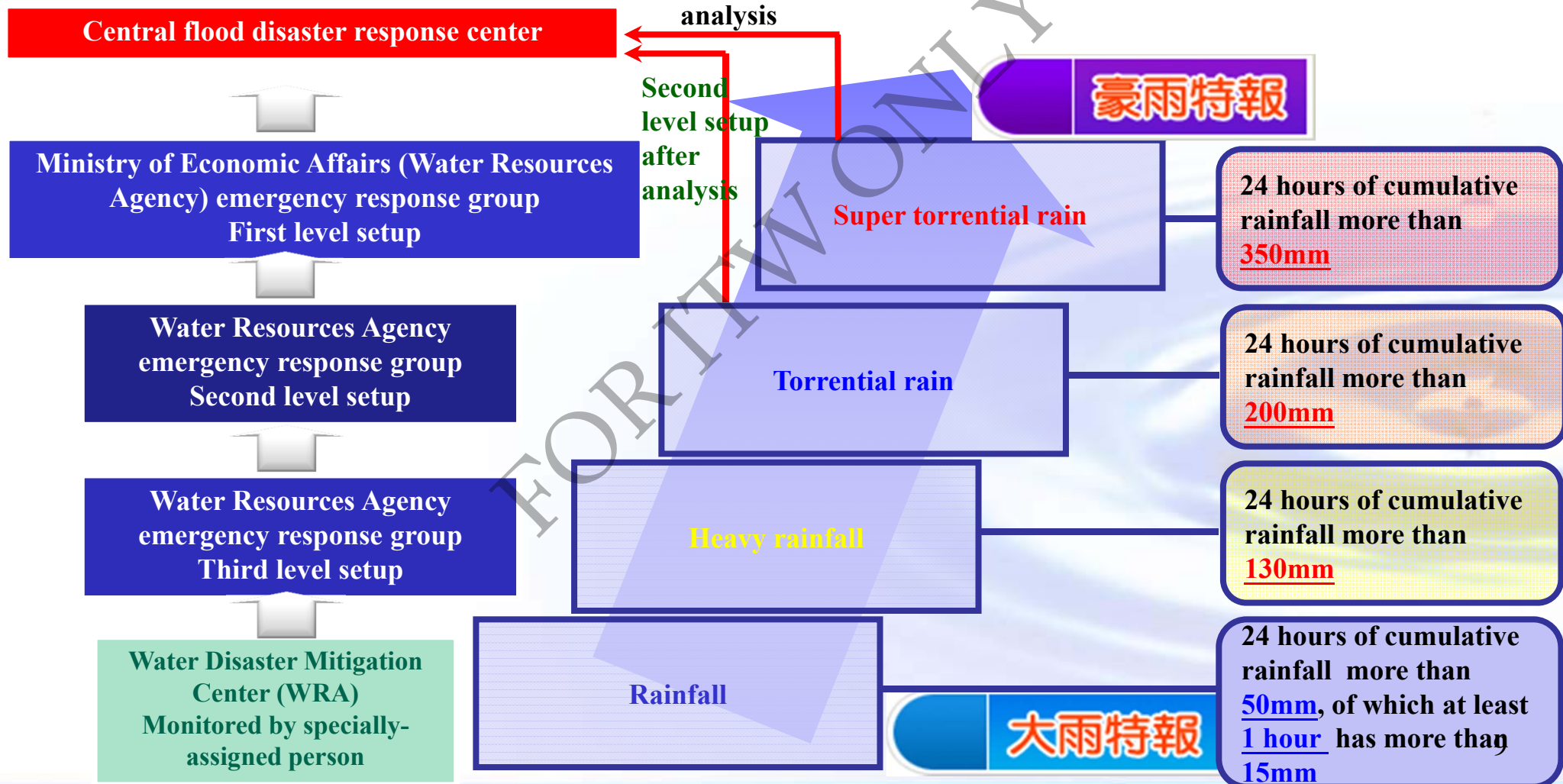




During flood season (May ~November) 24hr : Assign coordinator to move into central disaster response center

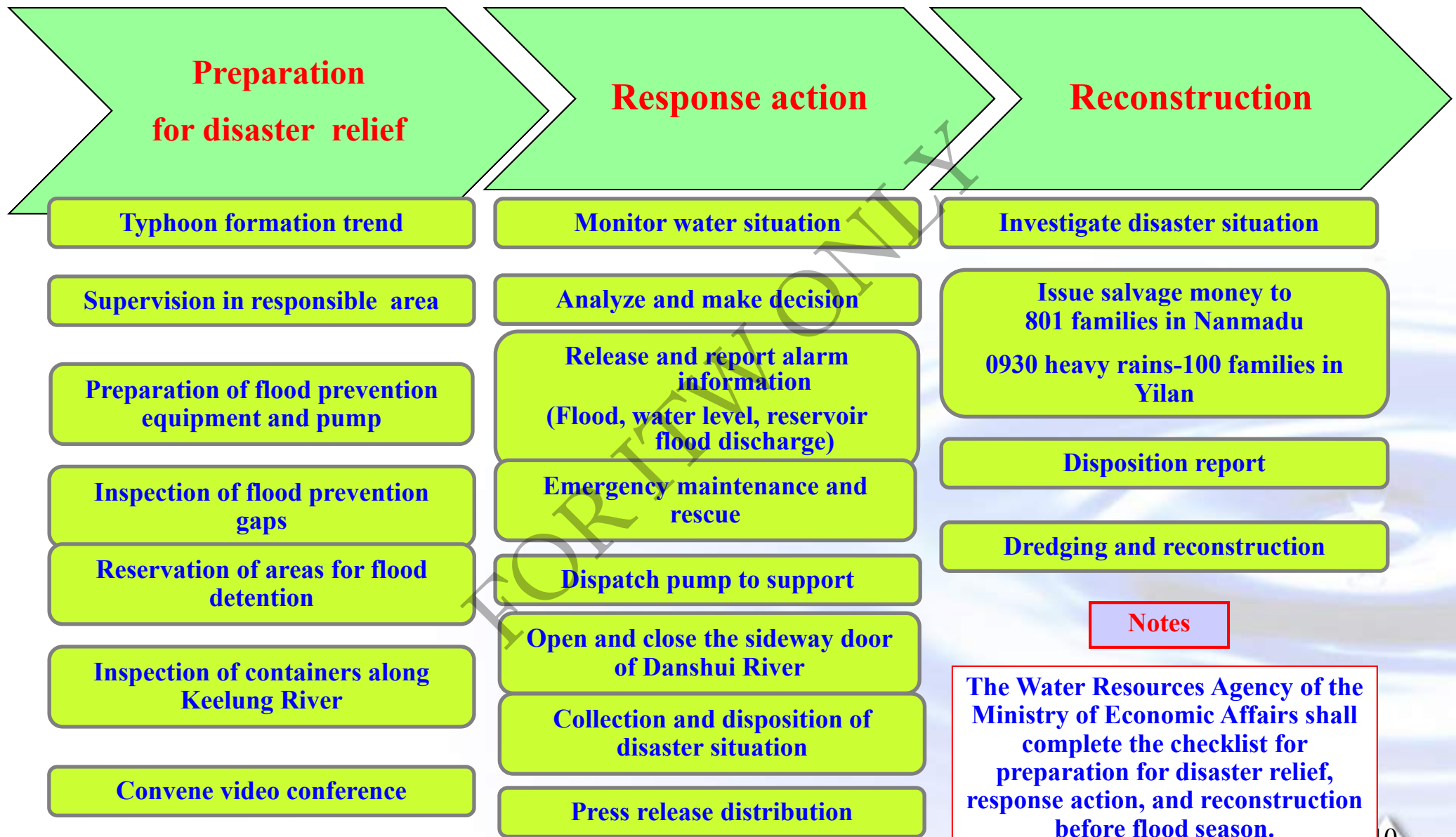
First level  
setup after  
analysis

Operation key points of central disaster response center



#### IV. Response Action to Flood Prevention

#### Key works in flood prevention response



颱風警報

# Sea typhoon alarm

Central disaster response center

Second level setup

Ministry of Economic Affairs  
(Water Resources Agency)  
emergency response group

Second level setup

Water Resources Agency  
(River Bureau) emergency  
response group

Second level setup

Cities and counties disaster  
response center

Villages and towns disaster  
response center

Village office

30 hours left for  
preparation

Issue sea typhoon  
alarm

hours

Respond in  
advance

- Setup according to superior instructions
- Disaster response centers are key points for operation

颱風警報

Sea and land typhoon alarm

Central disaster response center

First level setup

Ministry of Economic Affairs  
(Water Resources Agency)  
emergency response group

First level setup

Water Resources Agency  
(River Bureau) emergency  
response group

First level setup

Cities and counties disaster  
response center

Villages and towns disaster  
response center

Village office

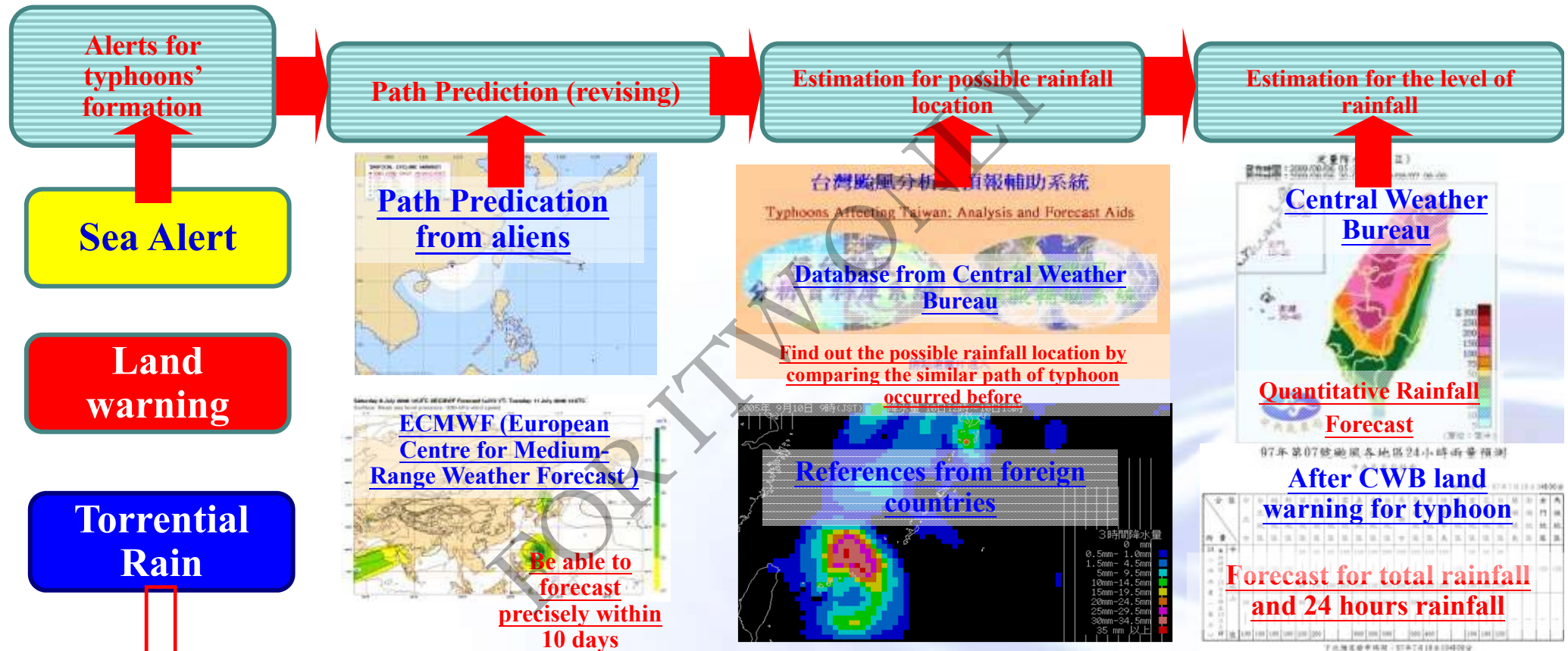
18 hours left  
for preparation

Issue sea and land typhoon  
alarm

Respond  
in  
advance

- Setup according to superior instructions
- Disaster response centers in each county and city are the key points for operation (for example: it is estimated that a level 7 typhoon will arrive in 8 hours)

Based on information about typhoon or torrential rain: **Predicting the possible flood-prone areas to carry out flood prevention response**



- 1.Focus on the warning district
- 2.Attention to the latest rainfall forecast
- 3.Flood prevention for targeting areas
- 4.Investigate disaster situation for targeting areas

Strengthen the preparation for flood and early dispatched mobile pumps

Report to the local government for early evacuation

# 【Preparation before flood season】

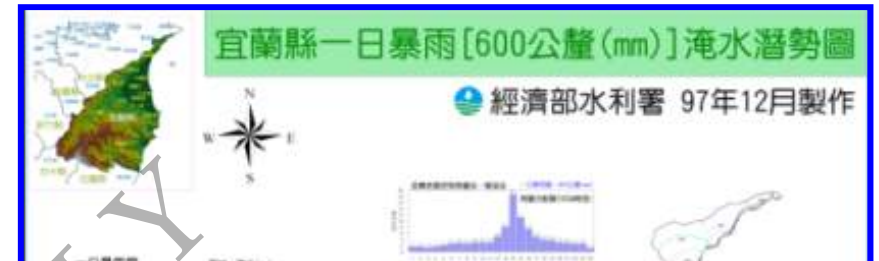
Preparation and application of flood trend charts

Flood trend charts on the county and city level



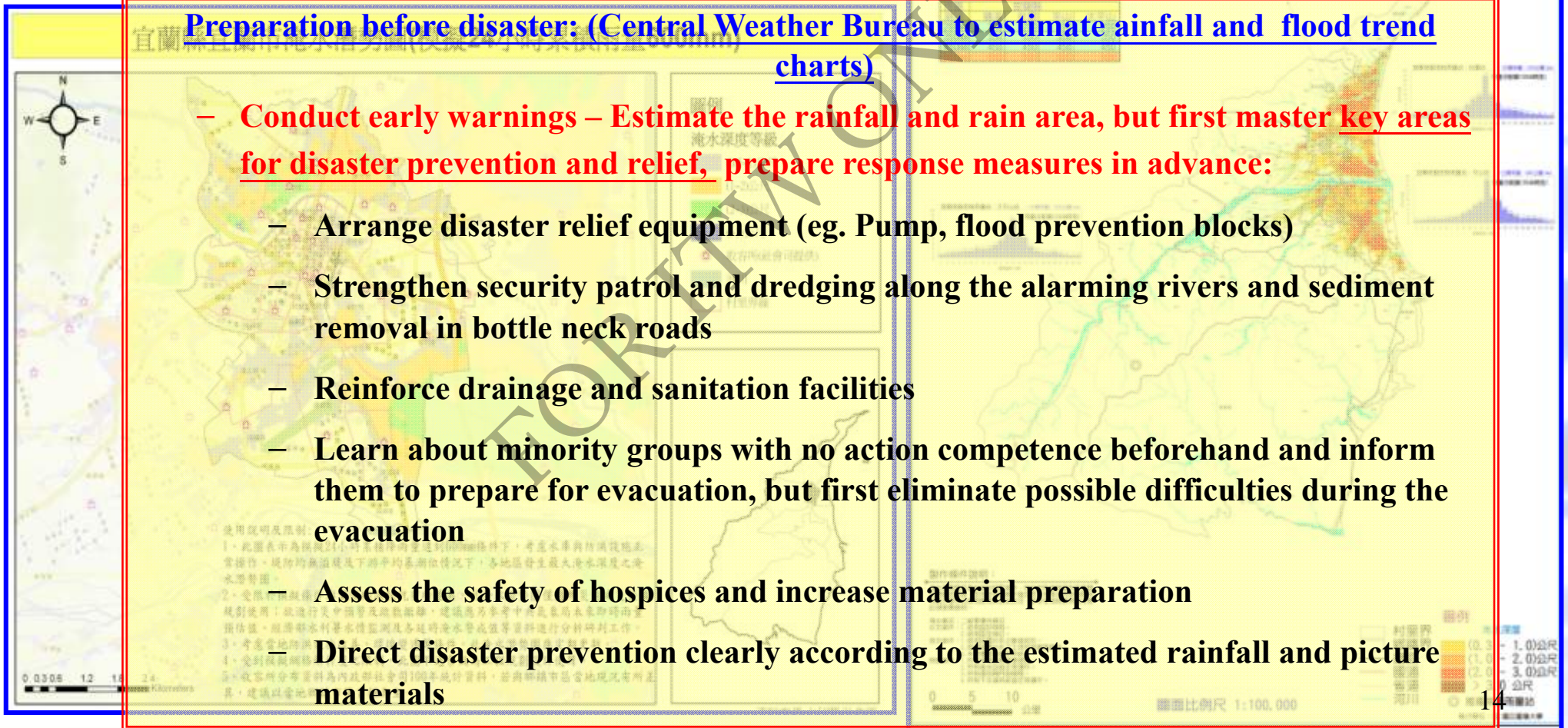
Plus

Flood trend charts on the town and village level

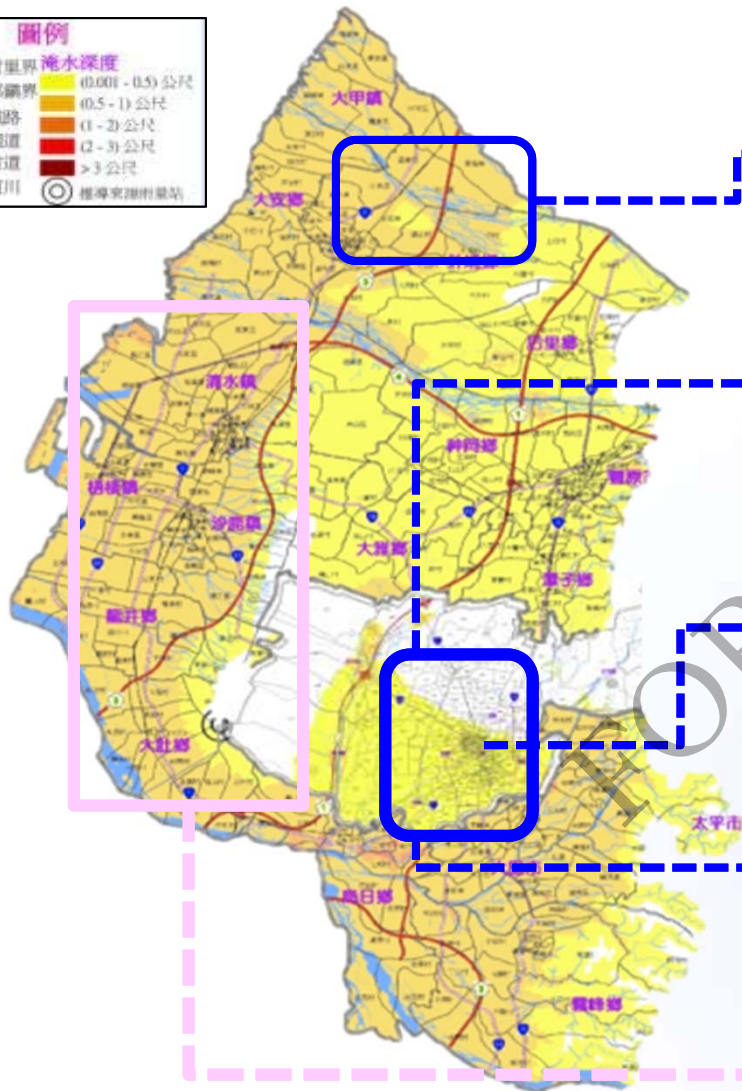


## Preparation before disaster: (Central Weather Bureau to estimate ainfall and flood trend charts)

- **Conduct early warnings – Estimate the rainfall and rain area, but first master key areas for disaster prevention and relief, prepare response measures in advance:**
  - Arrange disaster relief equipment (eg. Pump, flood prevention blocks)
  - Strengthen security patrol and dredging along the alarming rivers and sediment removal in bottle neck roads
  - Reinforce drainage and sanitation facilities
  - Learn about minority groups with no action competence beforehand and inform them to prepare for evacuation, but first eliminate possible difficulties during the evacuation
- Assess the safety of hospices and increase material preparation
- Direct disaster prevention clearly according to the estimated rainfall and picture materials



# Application of flood trend charts (County and city flood trend charts)



Strengthen security patrol and dredging along the alarming rivers and **sediment removal in bottle neck roads.**

**Arrange disaster relief equipment** (eg. Pump, flood prevention blocks)

Learn about **minority groups with no action competence** beforehand and inform them to prepare for evacuation, but first eliminate possible difficulties during the evacuation

Reinforce **drainage and sanitation facilities**

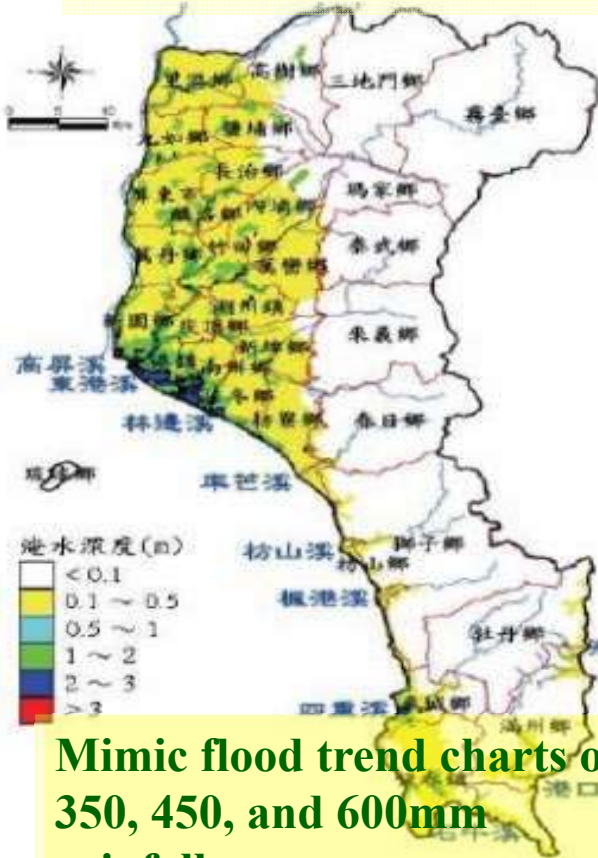
Enhance the preparation of goods and materials and the **planning of delivery routes**

# 【Disaster early warning】

Flood trend charts + 24-hour rainfall forecast

First master the flood-prone areas to carry out flood prevention response and evacuation

## 24-hour rainfall flood trend charts



Mimic flood trend charts of 200, 350, 450, and 600mm rainfalls

圖6-2-8 屏東縣600毫米日降雨量之淹水潛勢圖

## 97年第07號颱風各地區24小時雨量預測

中央氣象局發布

## Land typhoon alarm

分區	台北	台中	台南	高雄	基隆	新竹	苗栗	彰化	雲林	嘉義	屏東	南投	花蓮	台東	澎湖	金門	馬祖
24小時雨量	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
雨量	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
雨量	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
雨量	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

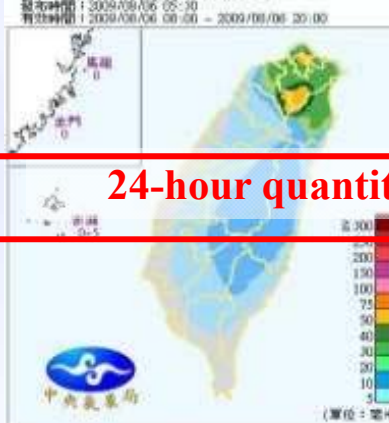
## 24-hour rainfall forecast

下次預定發布時間：97年7月18日10時00分

+

+

## 雨量降水預報(1)



## 24-hour quantitative rainfall forecast

## 雨量降水預報(2)

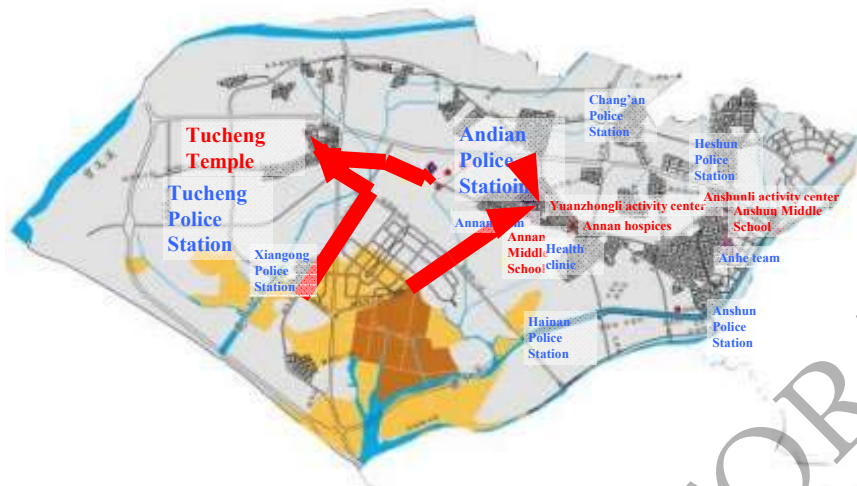


## Ordinarily

# Complete the prevention and relief plan for flood-prone areas before flood season

**Prepare prevention and relief plan for flood-prone areas according to flood trend charts and historical flood experience**

## Annan District, Tainan City Flood-prone areas and evacuation map



- 水災收容所
  - 台南市醫療單位
  - 台南市消防單位
  - 台南市警察單位
  - 水系
  - 台南市廓面圖
  - 台南市安南區範圍
- 台南市淹水潛勢  
日雨量450mm
- 0.0m - 0.5m
  - 0.5m - 1.0m
  - 1.0m - 2.0m
  - >2.0m
- 疏散路線

**Master beforehand the flood-prone areas and relevant prevention and relief objects, hospices, evacuation routes, and the location of mobile pumps, sand bags and gabions, etc.**

表 2-1 屏東縣水災危險潛勢地區保全計畫表

水災危險潛勢地區 (鄉鎮市-村里)	保全 戶數	保全 人數	避難處 所	避難所地址	疏散撤離通報人員 (村里長)	聯絡電話
里港鄉-中和村	330	1887	土庫國小	里港鄉中和村(路)35	村長：尤啓精	0939360106 08-7731717
里港鄉-彌力村	177	1056	三和國小	屏東縣里港鄉土庫路 111-3 號	村長：梁崑宗	0935460956 08-7731520
鹽埔鄉-洛陽村			洛陽社區	鹽埔鄉洛陽村四維路 103 號	村長：黃錦達	0953272936 08-7031406
九如鄉-大埤村			九如鄉大埤村大仁街	70 號	村長：許新米	0938581617 08-7392646
九如鄉-後庄			九如鄉後庄村後庄路	173 號	村長：陳權華	0956687685 08-7757693
九如鄉-九明村	558	1887	老人文康 活動中心	九如鄉九明村九龍路 55 號	村長：陳復	0937389123 08-7390928
九如鄉-三塊村	504	1913	三多國小	屏東縣九如鄉三塊村三 民路 307 號	村長：葉天任	0937574873 08-7750873
九如鄉-洽興村	468	1800	洽興社區 活動中心	九如鄉洽興村平和路 22 之 1 號	村長：陳朝評	0935905277 08-7752571
九如鄉-玉水村	169	1572	玉水社區 活動中心	九如鄉玉水村清水路 73 號	村長：吳清吉	0911716532 08-7391636
屏東市-海豐里	295	1056	海豐國小	屏東市海豐街 3 號	里長：施世男	0918236929 08-7376190

Minority groups needed  
to be assisted shall be  
specially marked



## 【Early warning during disaster】

Initially provide the latest information on the water situation and release real time alarm information

Alarm Category	Release 2nd level alarm	Release 1st level alarm
Flood alarm (internal water)	Real time rainfall > alarm rainfall (2 <sup>nd</sup> level rainfall alarm)	Real time rainfall > flood and ponding rainfall (1 <sup>st</sup> level rainfall alarm)
Water level alarm (external water)	Observed water level > 2nd level alarm water level	Observed water level > 1st level alarm water level
Reservoir flood discharge alarm	Prepare for flood discharge	Start flood discharge
Reservoir turbidity alarm	-	Reservoir turbidity > alarm turbidity

### Definitions of flood alarm grading:

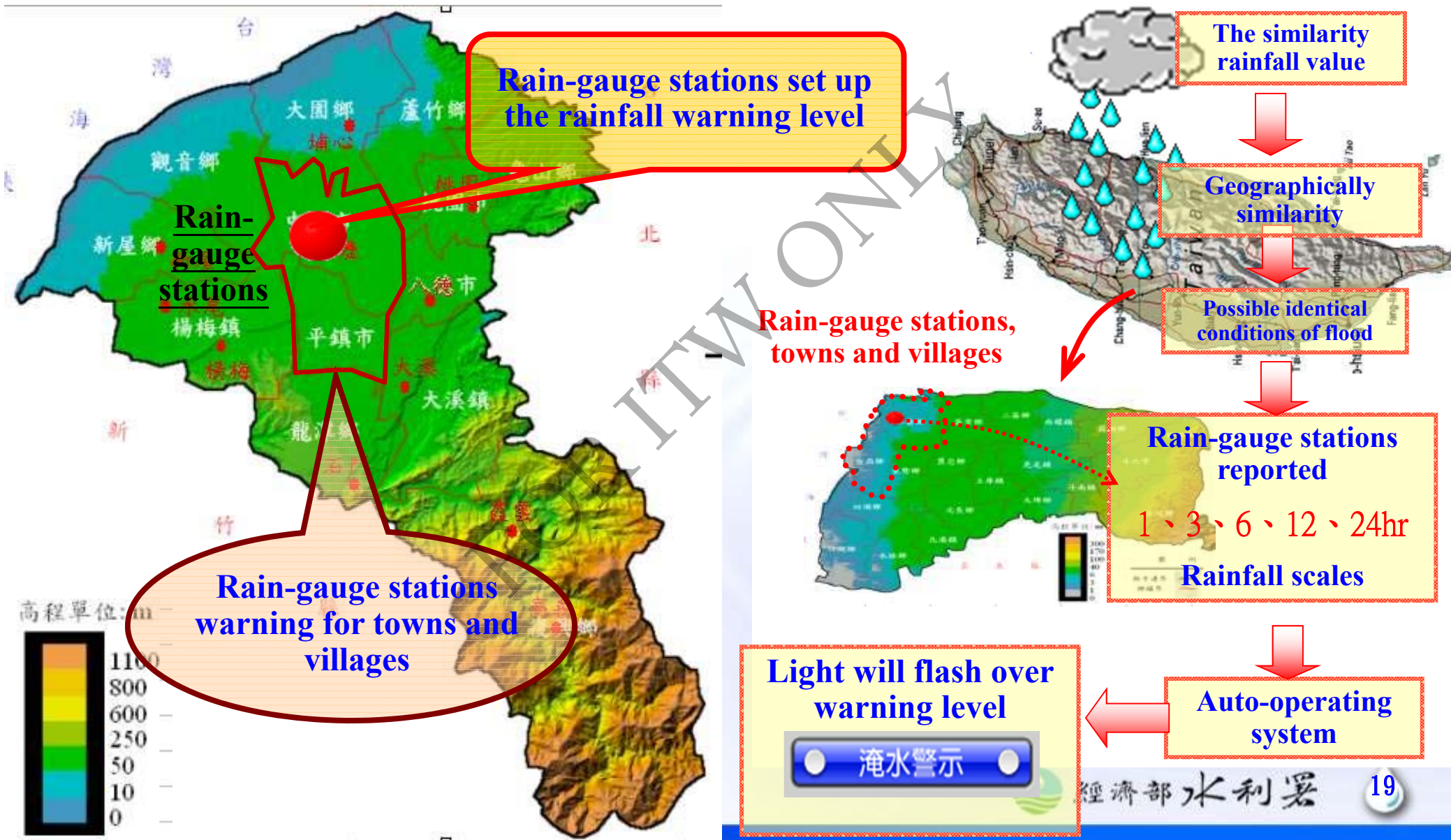
- **2<sup>nd</sup> level alarm:** if the area (city, county, town, district) issuing the flood alarm suffers from **sustained rainfall** and **70% possibility** that flood-prone areas within the administrative area will be **ponding and flooded within 3 hours**.
- **1<sup>st</sup> level alarm:** if the area (city, county, town, district) issuing the flood alarm suffers from **sustained rainfall** and **70% possibility** that flood-prone areas within the administrative area **have already begun ponding and flooded**.

**Notes:** The accuracy of the flood alarm is affected by such factors as uneven distribution of rainfall, density of rainfall station, water level of the rivers, sea level, blocks in water discharge routes, etc. It can be made according to the monitoring of real time rainfall (eg. QPESUMS) and local rainfall situations.



# Flood Warning System (Internal Water)

National rainfall warning level and flood forecasting system- invented by the Water Disaster Mitigation Center from Water Resource Agency of Taiwan

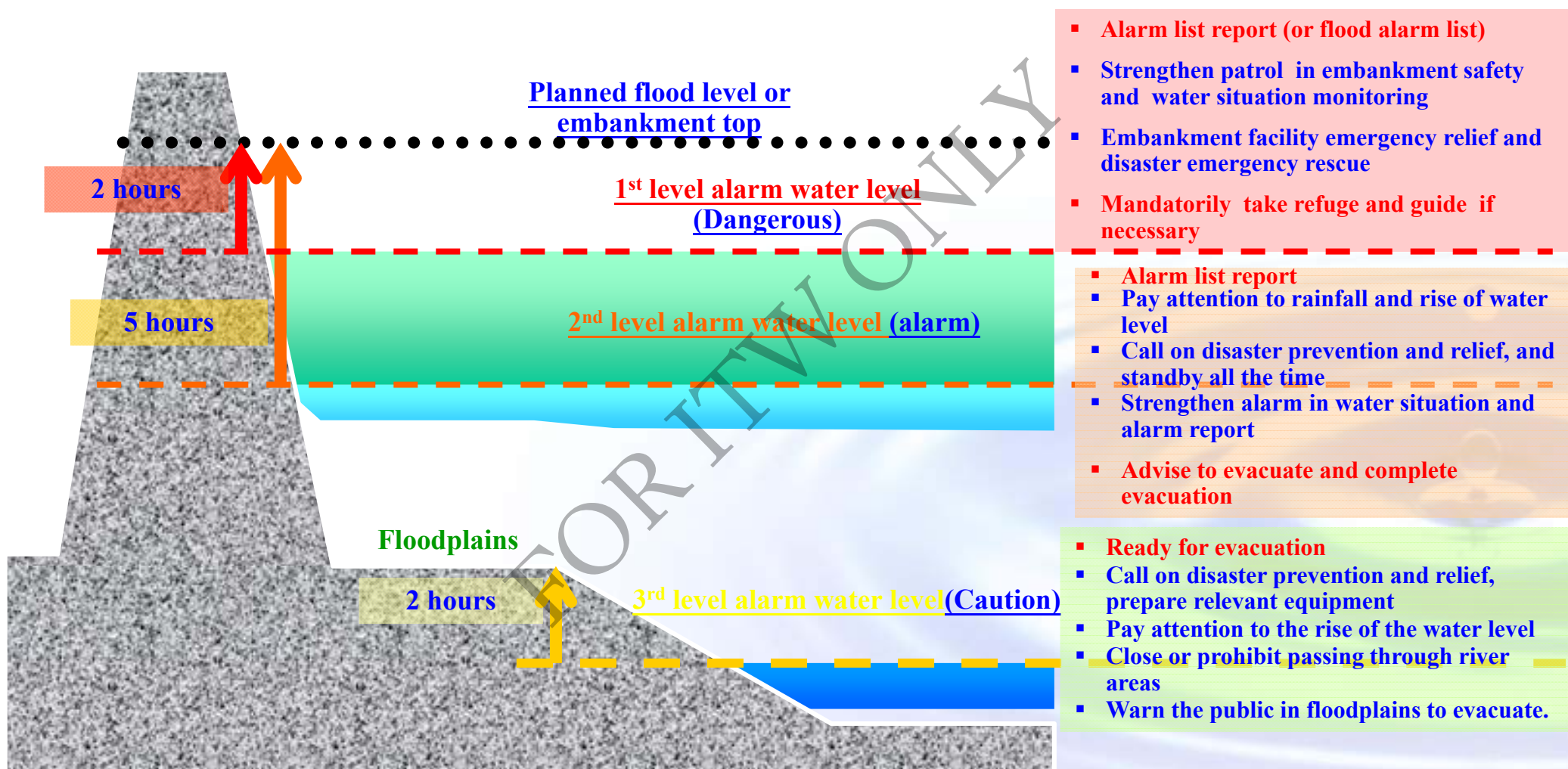


## Light will flash over warning level



# Early warning for external water floods (alarm for river water level)

Rivers under central administration have setup water level stations and stipulated alarm water levels (3 levels) to coordinate to monitor OPESUMS real time rainfall, conduct early warning for river (external water) floods and report the disposition.



- Alarm list report (or flood alarm list)
- Strengthen patrol in embankment safety and water situation monitoring
- Embankment facility emergency relief and disaster emergency rescue
- Mandatorily take refuge and guide if necessary

- Alarm list report
- Pay attention to rainfall and rise of water level
- Call on disaster prevention and relief, and standby all the time
- Strengthen alarm in water situation and alarm report
- Advise to evacuate and complete evacuation

- Ready for evacuation
- Call on disaster prevention and relief, prepare relevant equipment
- Pay attention to the rise of the water level
- Close or prohibit passing through river areas
- Warn the public in floodplains to evacuate.

- Rivers under central administration have already setup alarm water levels.
- Rivers under county and city administration have not yet setup alarm water levels.

# Reservoir flood discharge alarm

## Reservoir flood discharge operation procedures



Monitoring and judgment on water situation (master any time)

Flood discharge according to Reservoir Flood Prevention Operation Regulations

Complete downstream and notice report 1 hour before flood discharge

Report to and notify relevant authorities in downstream and activate downstream flood discharge alarm system

Activate downstream flood discharge alarm system



River Bureau disaster emergency response group  
County and city disaster emergency response groups  
County and city fire prevention bureaus, police stations  
County and city water resources bureaus (department)  
Relevant irrigation and water conservation associations and water supply companies

**Downstream village and town disaster emergency response center**

Other relevant departments and downstream village offices

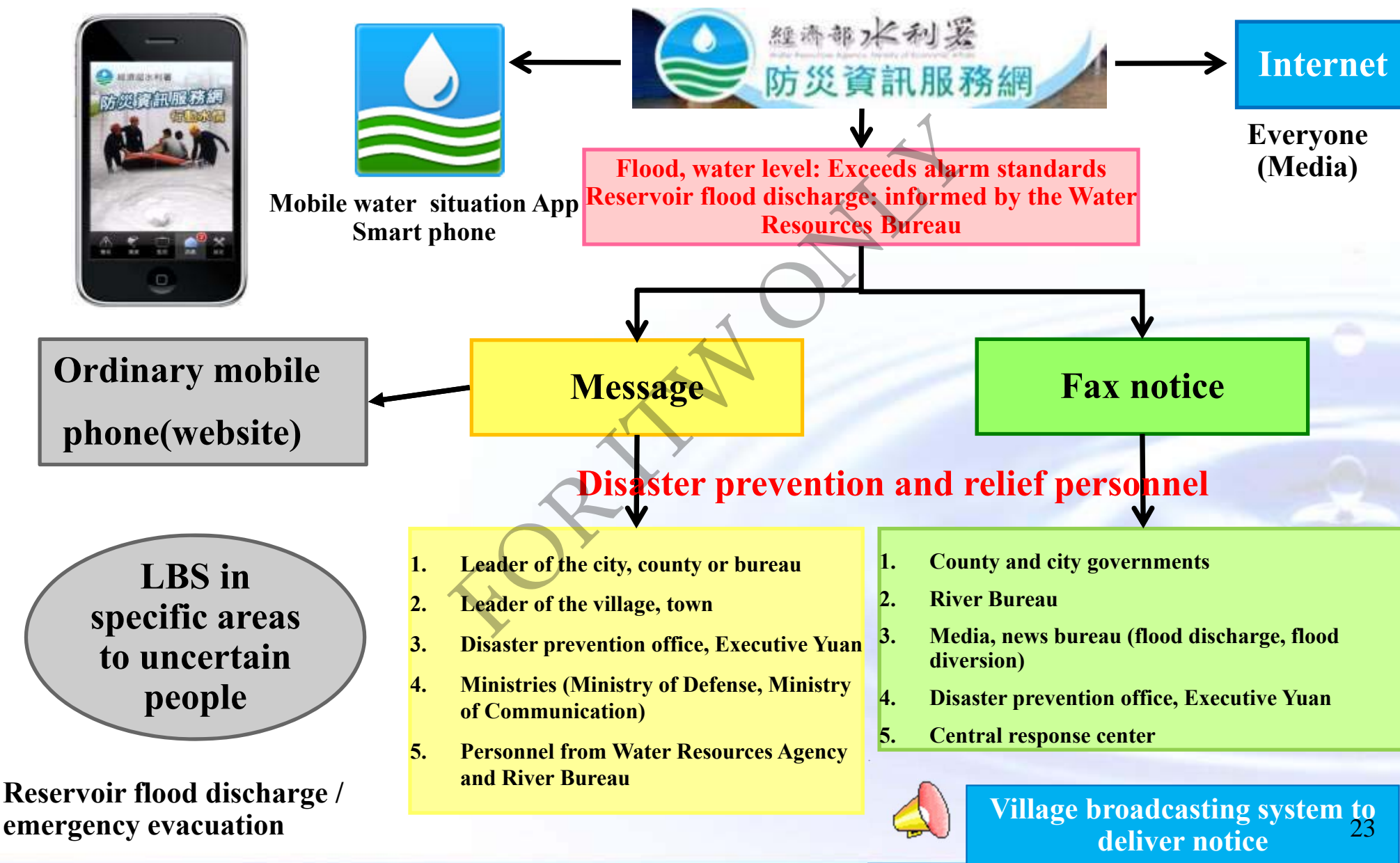
Reservoir flood discharge alarm

Reservoir flood discharge report list

Response group of Water Resources Agency

Release flood discharge information through communication media

# 【 Establishment of diversified information services 】



**■ Automatically** promptly, rapidly, and effectively deliver the notice

## Automatically create contents of notice list

## Automatically create contents of message

年度 2011 事件 國際新聞 類別 經濟新聞 通訊

# 經濟部暨水利署災害緊急應變小組警示單

發布時間 ☐ 年 ☐ 月 ☐ 日 ☐ 時 ☐ 分

颱風

室內

編號

版本

類型 ☒ 淹水潛勢 ☐ 水庫洩洪 ☐ 水庫崩塌 ☐ 警戒水位

警戒區域 詳如附件之主要警戒單位 斜水 中央災害應變中心

警戒事項

一、依據經濟部水利署降雨-淹水警戒系統，☐ ☐ 雨量超過去 ☐ 時累積降雨 ☐ 公厘，下列地區未來一小時內有較高淹水潛勢：

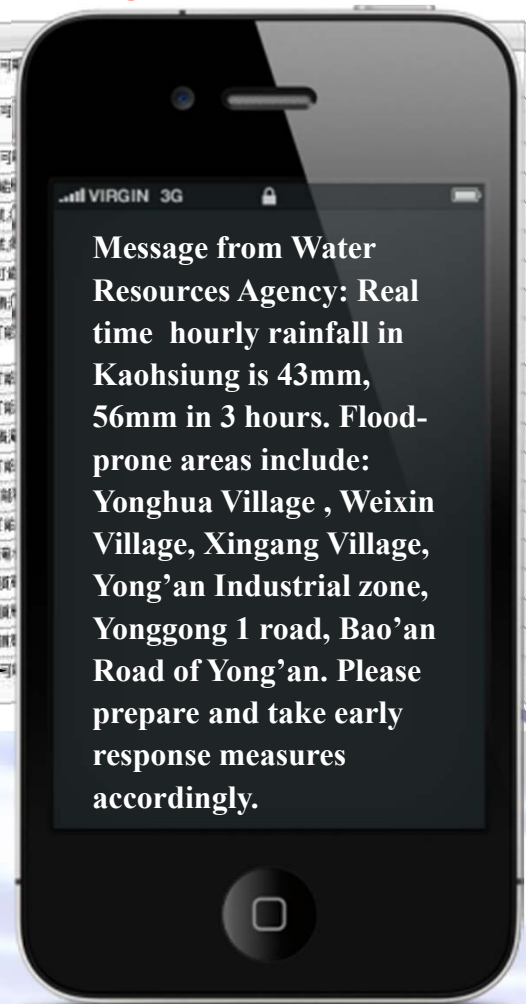
(一) 臺北市：公館鄉-台六線楊星隧道、穆東村、楊星村、穆南村、五谷村、五谷村、仁安村、大坑村；士林區-社子島地區、楊星里、臨溪里、社子島(富洲里、楊安里)、豐源街、中山北路附近(楊行里、忠誠里、國盛里)、中山北路、延平北路七-九校、承德路、穆行東路口；內湖區-大湖山莊街、康寧路三校(南湖國小)、康樂街一帶、東湖路、安康路、內湖路一段91巷；南港區-研究院路一、二段南港區、路一、南港區(近)、東新

## Fax report system

(Delivered to central disaster response center and relevant disaster prevention departments and governments)

二、

楊隆村

[illegible]

**Message from Water Resources Agency: Real time hourly rainfall in Kaohsiung is 43mm, 56mm in 3 hours. Flood-prone areas include: Yonghua Village , Weixin Village, Xingang Village, Yong'an Industrial zone, Yonggong 1 road, Bao'an Road of Yong'an. Please prepare and take early response measures accordingly.**

# Fax report system

**(Delivered to central disaster response center and relevant disaster prevention departments and governments)**

## Automatic message report

**(Delivered to central disaster response center and the leader of relevant disaster prevention departments and governments)**



2012.1.1  
正式推出

- Location based service (LBS): area information and alarm situation.
- Water situation information: provide information on rainfall, water levels and reservoir situations, etc.
- Alarm situation: provide alarm information about floods, river water levels, and reservoirs.
- Picture material (weather): provide query on pictures relating to alarms, weather forecasts, etc.
- CCTV monitoring: provide CCTV monitoring image to master on-site situations.
- Information delivery: actively deliver messages and integrate the information of disaster prevention related departments.

## Water Resources Agency 「Mobile water situation」 App installation(4 steps)

1. Click "App Store"

2. Search "mobile water situation"

3. Click "FREE"

4. Click "INSTALL"



Three easy steps to receive flood warning and protection information



Notes: email info isn't a necessary requirement

## ■ Flood Discharge Emergency Notification

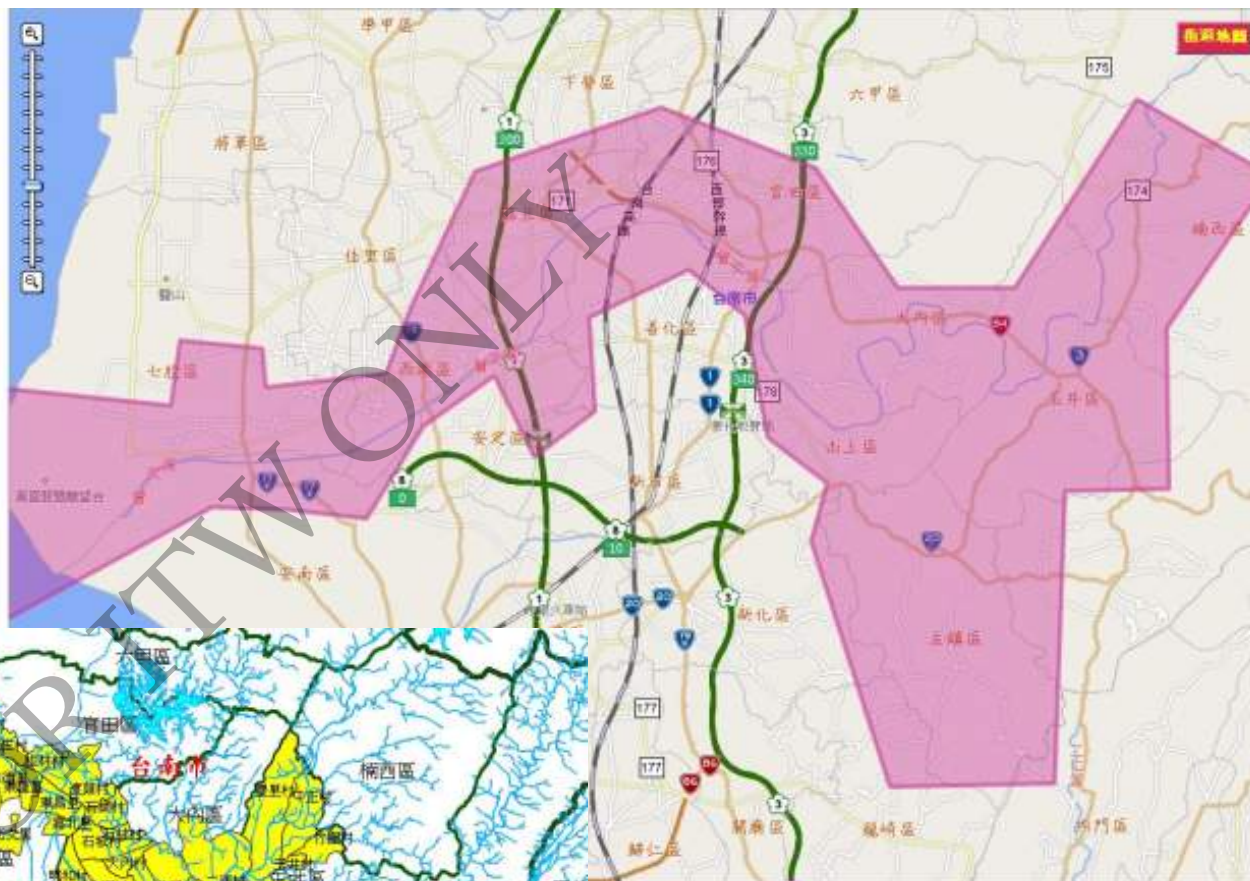
For nonspecific individuals in a designated warning area.

(Begin in Tseng-Wen Reservoir area )

For the Tseng-Wen Reservoir spillway, people receive the spillway alarm once they enter the alert zone.

With the help from Chunghwa Telecom this system now can reach 80% of population living or travelling in the flood –warning area.

## Alert text message for a designated area



Setup a flood prevention volunteer service team

- Assist in inspection of water conservation facilities
- Assist in disaster report
- Assist in evacuation
- Assist in communication



Independent flood prevention community  
(Independent alarm and evacuate)



Bring together the help from 7-11 stores and gas stations across the island in gathering up-to-the-minute flood information



Public and Corporation

Volunteers : 1428  
 7-11 stores : 4890  
 Gas stations : 2137  
 Chinese Petroleum Corp : 690  
 CPC Franchise: 1374  
 Taiwan Sargar Corp: 73  
 Manufacture : 7  
 Industry area: 138



8,600

Flood reporting stations

Flood Alarm

Flood investigated

Telephone survey

Internet reporting system

Flooding condition report

Independent Alarm Broadcast



Cash register

Information Sending system

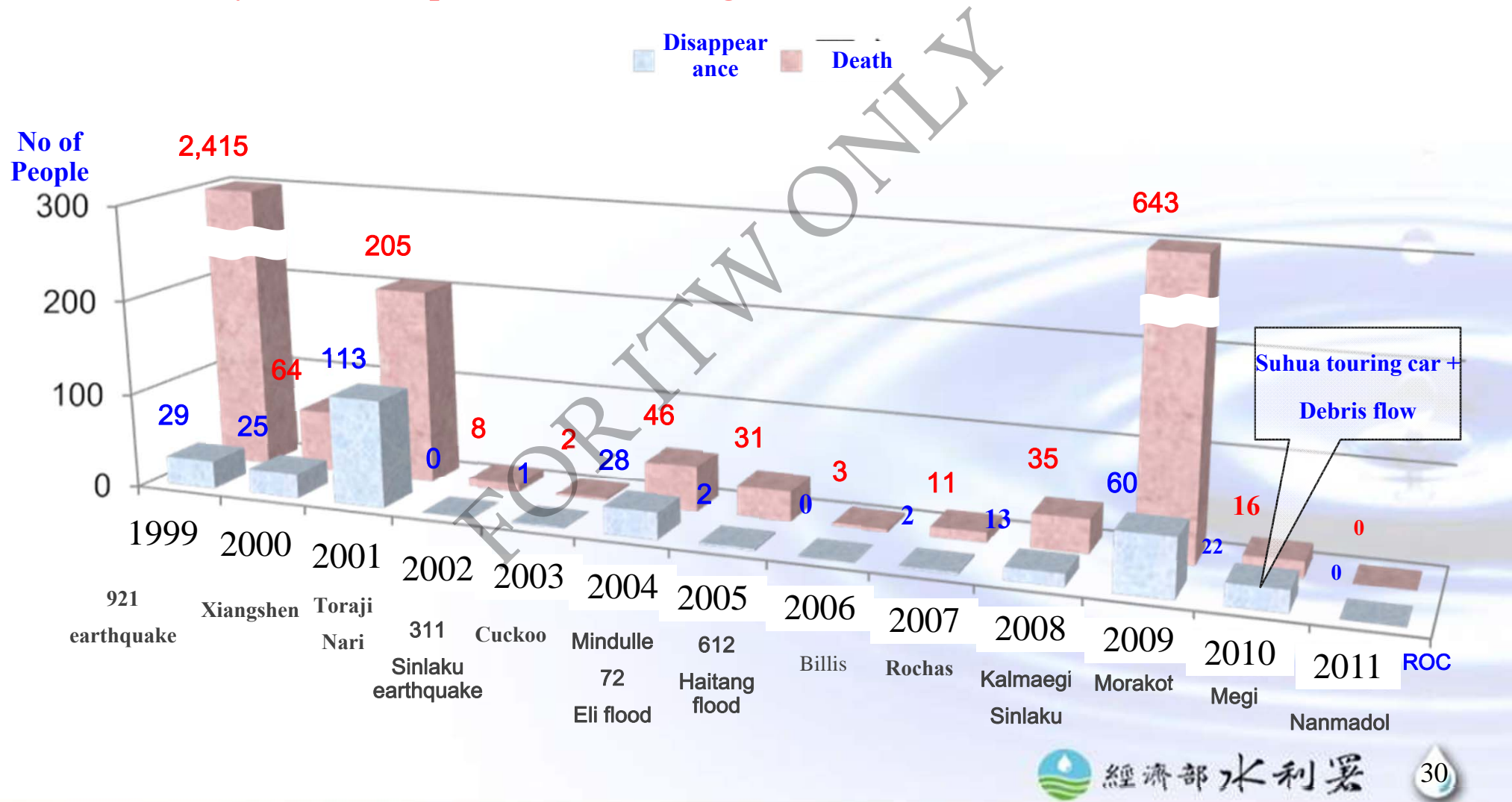


Display system

## V. Conclusion

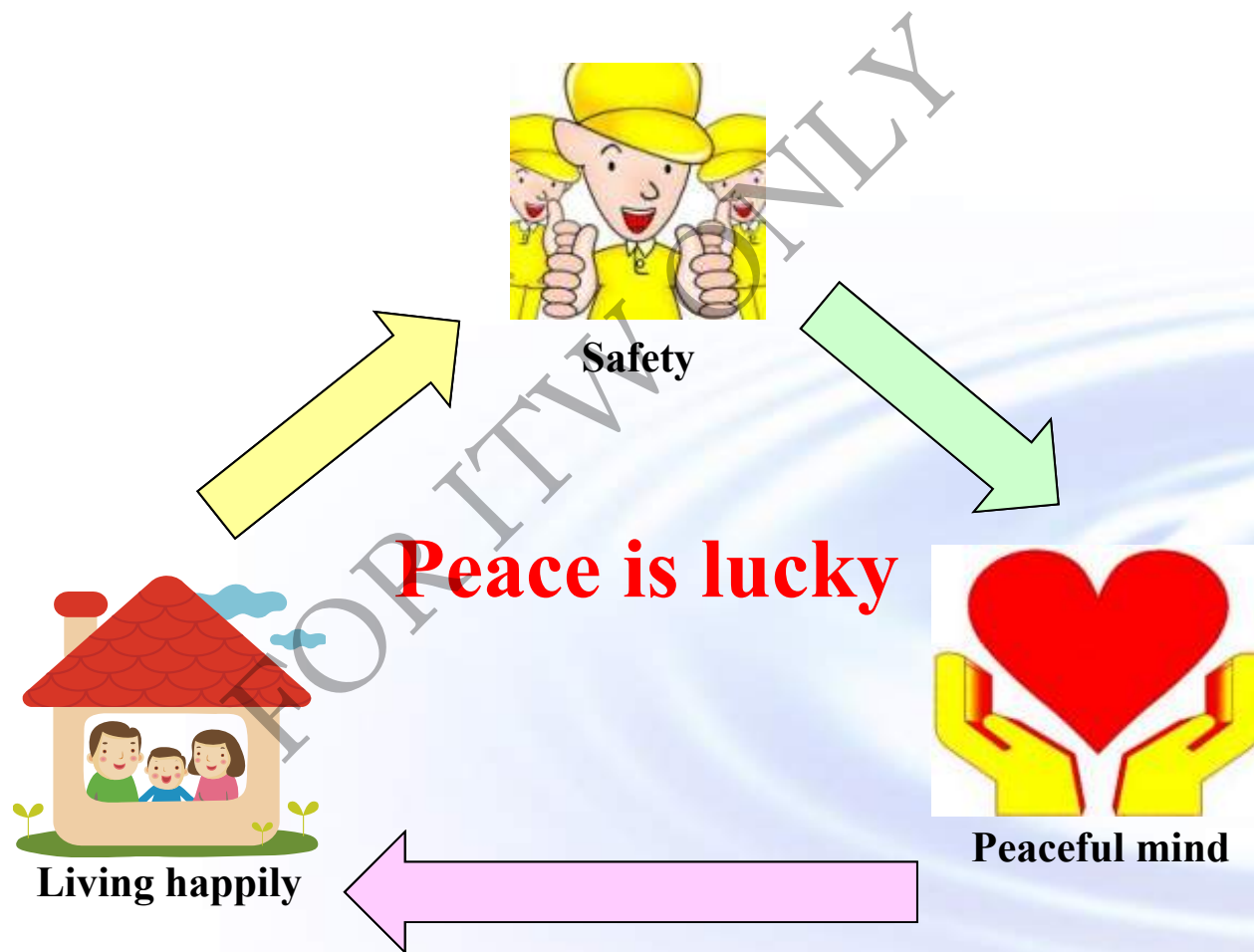
### Achieving the objective of “Zero casualties in floods”

Substantially reduce the potential of flooding and losses



Actively prevent disasters instead of providing relief for them afterwards

Make a safe and better environment for living happily





**May good weather  
always stay with us**

*Thank you.*  
*Please advise*