

# **Sustainability & Innovation: Lessons from Reconstruction after Typhoon Morakot in Taiwan**

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# World Media Attention (Films produced)



- Discovery Channel 「Eye on Taiwan – Surviving Morakot」
- NHK TV 「深層崩壊が日本を襲う」
- NGC 「Megastructure: Eco School」
- Singapore Media Development Board (Xtreme Production) 「Rebuild」
- NGC 「Rebuilding Taiwan – Beyond the Storm」
- NGC 「Rebuilding Taiwan – Reborn in Hope」

# The Threat of Climate Change



- Climate change disaster is upon us (UN, **Oct. 5, 2007**)
- UN warns climate change could trigger “mega-disasters” (John Holms, UN emergency relief coordinator, **June 7, 2010**)
- **2010 was the worst year ever for natural disasters.** 297,000 people died; 373 major disasters; 109 billion worth of loss; 89% of total people affected in Asia. (UN research)
- **2013 IPCC: Climate change has not stopped and man is the main cause.**

# Recent Major Disasters



## 1999 921 Chi-Chi Earthquake (Taiwan)

2004 1226 Indian Ocean Earthquake & Tsunami

2005 Hurricane Katrina (U.S.A.)

2008 512 Sichuan Earthquake (China)

## 2009 0808 Typhoon Morakot (Taiwan)

2010 Floods in Europe ,Pakistan and China

2011 0112 Earthquake (Haiti)

2011 Floods & Landslide in Rio de Janeiro (Brazil)

Floods in Queensland (Australia)

0222 Christchurch City Earthquake (New Zealand)

0311 Tohoku-Pacific Ocean Earthquake (Japan)

0324 Burma Earthquake, 2011

0904 Talas Typhoon (Japan)

0725~ Thailand Floods

2012 1029 Hurricane Sandy (U.S.A.)

2013 1109 Super Typhoon Haiyan (Philippines, Vietnam)

2015 0425 Earthquake (Nepal)

# Taiwan's Natural Challenge



- Lifting & Collapse Action
- Debris flow
- Typhoon
- Earthquake
- Heavy shower
- Corrosion & Degradation

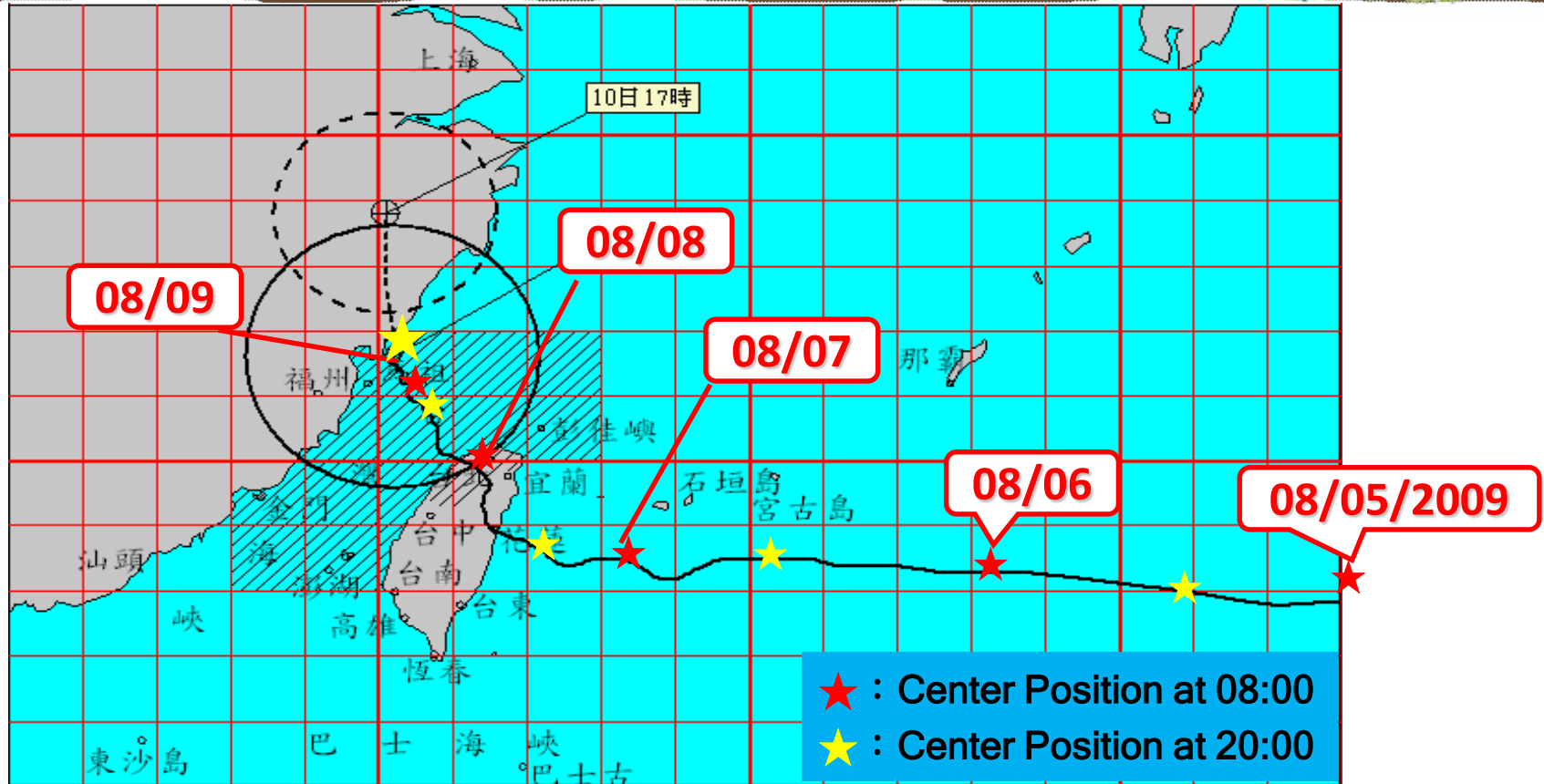
➔ **Ranked #1 country by  
2005 World Bank as**

# Taiwan's Natural Challenge



- Zurich Insurance reported that the high risky world metropolis to natural disaster are located in **Japan 、 China 、 Taiwan & Philippine**」 ◦ (2014/11)
- LLOYD'S & Cambridge Centre for Risk Studies reported on “World Cities Risk 2015 – 2025”: **Taipei, Tokyo, Istanbul, Osaka** exemplify high economic value cities **with high exposure to natural catastrophes**, interstate war and also market crashes and oil price shocks. (2015/9)

# Typhoon Morakot, 2009



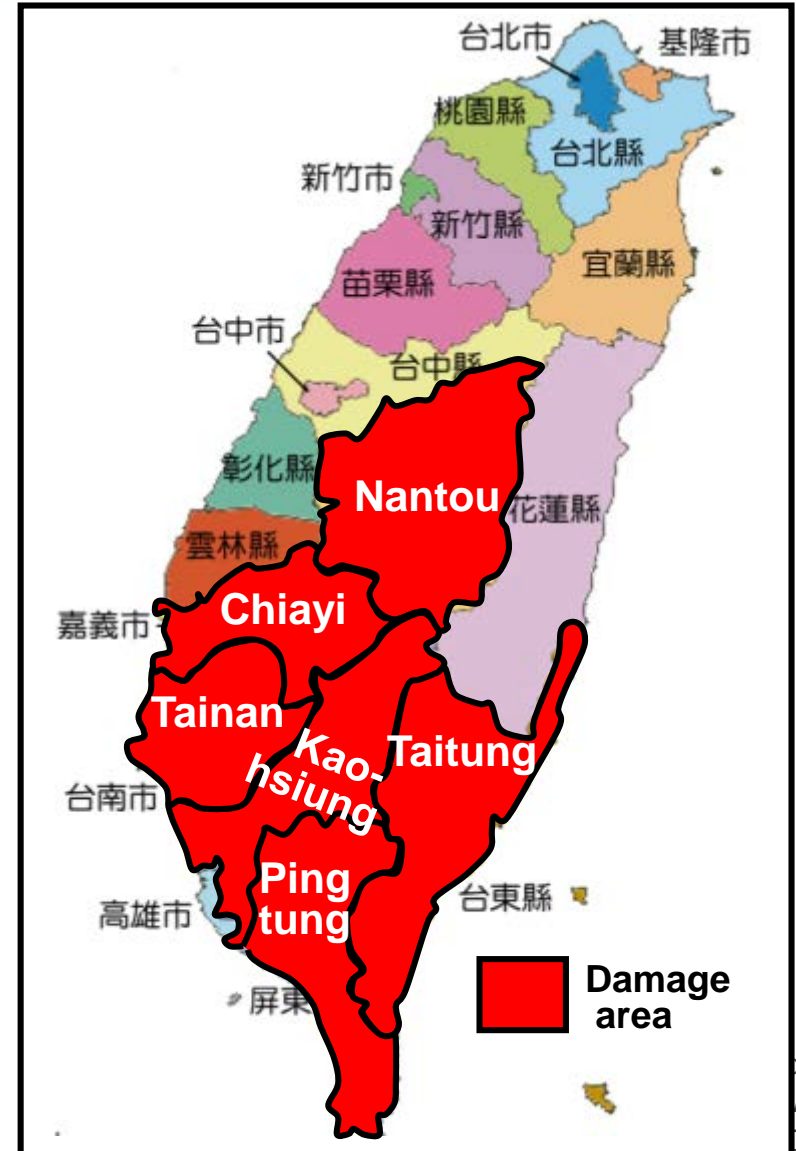
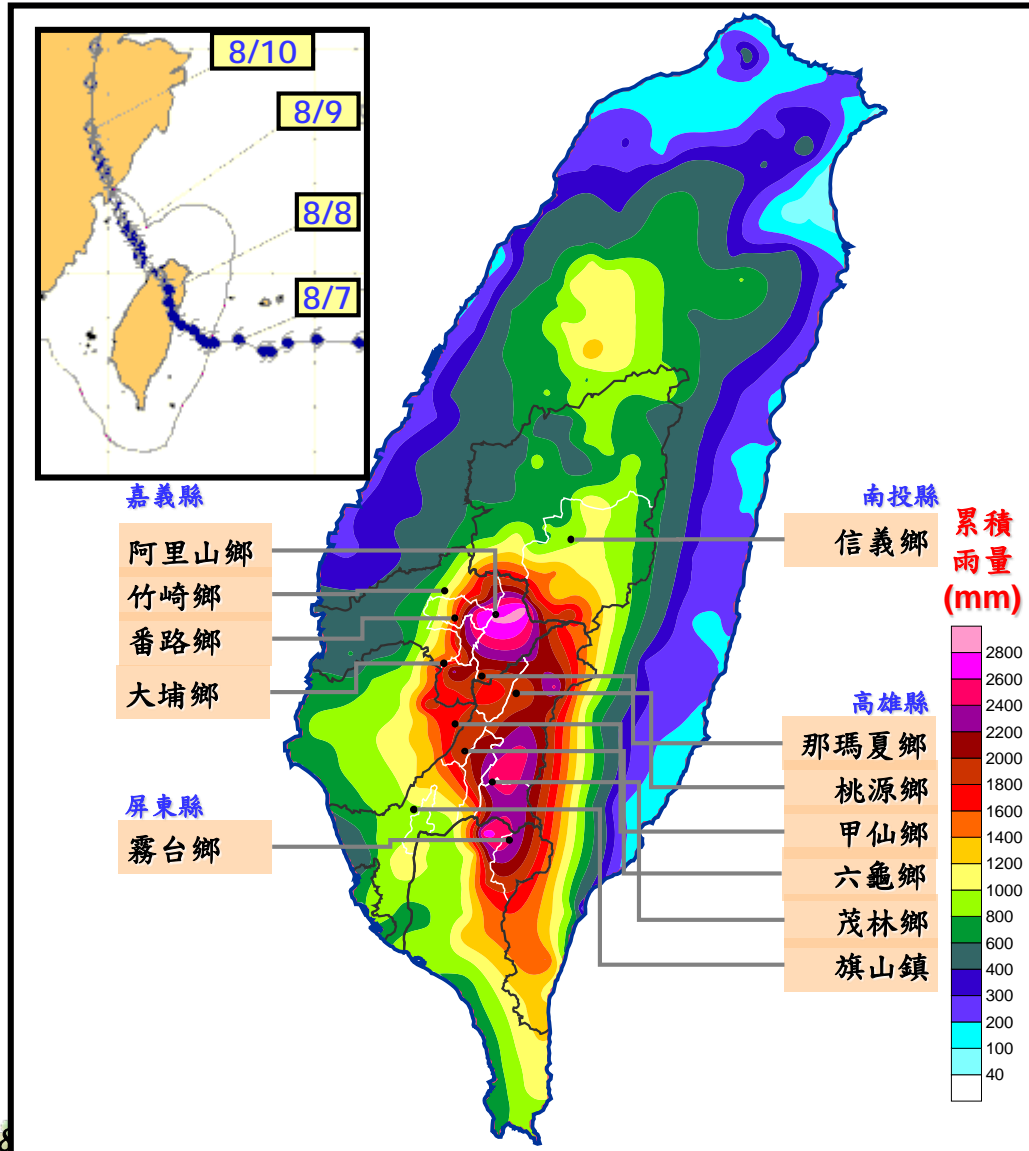
Aug 5-6 Moved fast toward Taiwan

Aug. 7 Slowed down and out skirt touched the island

Aug. 8 Made landfall at 00:00; Center left the island at 14:00 at a very low pace; exerted substantial impact on the whole island

Aug. 9 Gradually moved toward China

# Accumulated Max. Rainfall 2,854mm (Alishan)



# World Rainfall Record



- The highest accumulated rainfall in Taiwan's history

Alishan (阿里山) reached 2,854mm in 3 days

- Compared with World Record

	Morakot	La Reunion Aurere
24 hrs duration	1,623.5 mm	1,825mm
48 hrs duration	2,361 mm	2,467mm

**A dramatic impact to Taiwan !!!**



# Compound Disasters



**Mega-Typhoon**

**Continuous heavy showers for 3 days**

**Floods**

**Landslides**

**Debris and mudflow**

**Mega amount of driftwood**

**Tributary dammed lakes**



# Damage



## ■ Disaster Area:

- 11 counties, 50% of total land area
- 9.16 M people, 40% of Taiwan population

## ■ People affected by the disaster: 510,668

- flood damage: 491,477 people
- landslide and river scour: 19,191 people

**Three quarters of dislocated refugees are indigenous people.**



# Damage



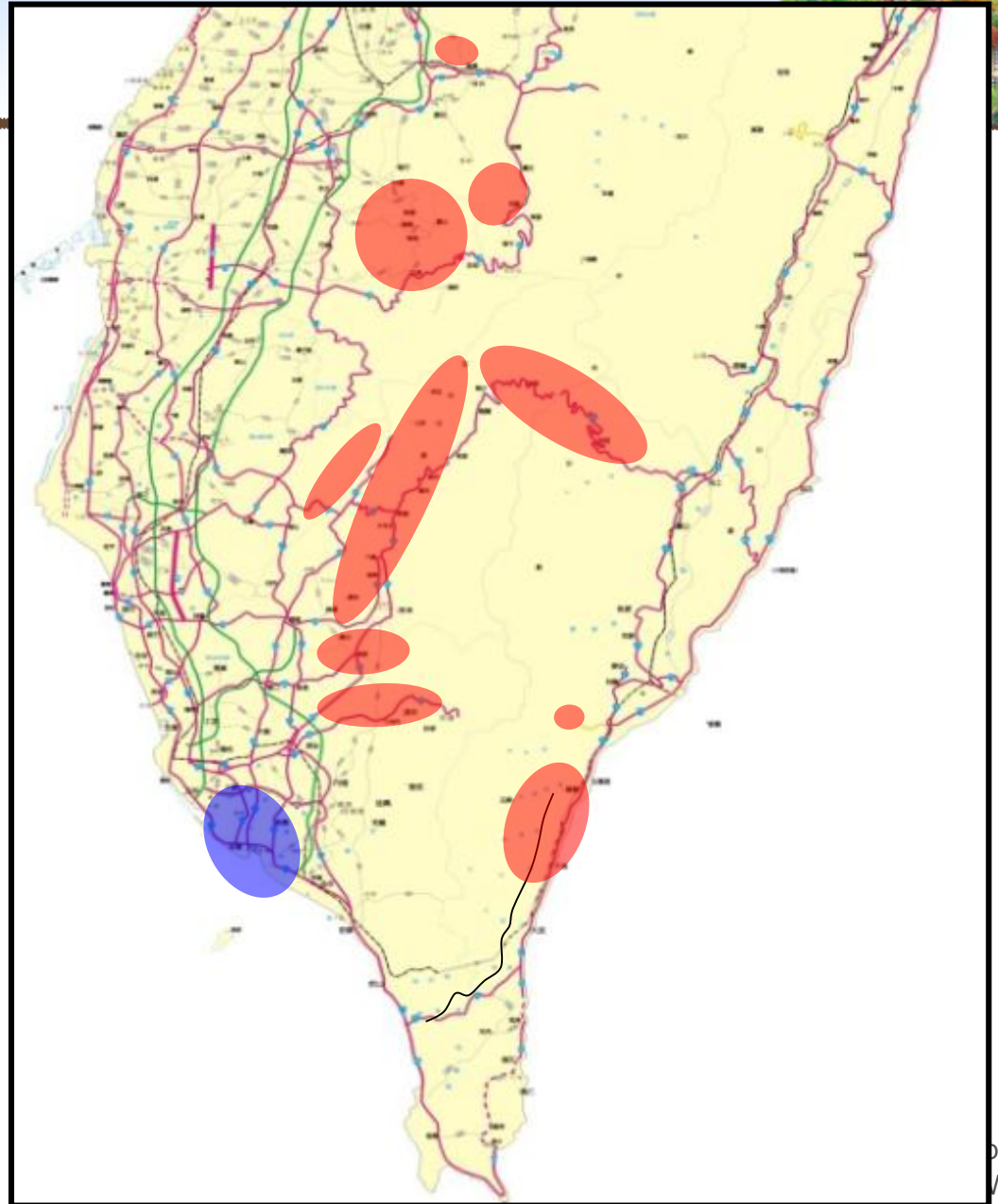
- 699 people died and missing; 4 people seriously injured
- 1,766 houses damaged seriously; 28 b NT\$ of agricultural loss
- Total lose 199.8 b NT\$ (1.6% GDP)
- More than 161 inhabitant areas found unsafe
  - 62 indigenous tribe sites
  - 99 non-indigenous spots

# Seriously Damaged Areas

● Isolated Islands in  
Mountain Area

● Coastal Flooded  
Area

**10 tributary dammed  
lakes were formed**



# Flooded Areas



Aug.  
8



Pingtung County:  
Linbian, Jiadong,  
Donggang,  
Xinyuan  
Townships



# Xiaolin Village

- Deep layer landslide
- 459 deaths

Before



After



# Gilu Tribe - Wutai Township





Destroyed sections of  
台 Prov. Hwy. 24



Wujia Bridge



Roadways destroyed by  
土石 mudslides 毀損

Ailiao N. River

Landslide area

No. 1 Bridge  
 destroyed

Destroyed roadways

Wujia Bridge destroyed

Wutai Elementary branch  
 campus

Shenshan  
Community



Wutai (before)



Destroyed  
roadways

Wutai  
Elementary

Wutai  
Village

**Massive landslides at Wutai  
Village**

# Flooding of Taimali River, Taidung



Before



After



2014  
0817  
從莫拉克  
颱風災後  
重建看見  
永續與創  
新

# Challenges of Reconstruction



- Large debris amounts, lack of dredging roads
- Loosing land (slopes, riverbeds etc.)
- Isolated islands for typhoons and heavy rains
- High reconstruction budget
- The frequent evacuation and relocation of disaster refugees

The reconstruction speed and relocation of refugees are competing with time of forthcoming rainy and typhoon season to avoid subsequent disaster.

# Step Down, JC CHERN



2009.11.19 Kaohsiung County



2009.11.25 Executive Yuan



2009.11.29 Namasha Township, KH



2009.12.10 Taoyuan Township, KH



# Overnight Rally on Anniversary



The President Office



# Special Features of Reconstruction



- **Safety, Efficiency, Respect, and Innovation (SERI)**
- **Joint Efforts of Government, NGOs, and Enterprises (Social Management Systems)**
- **Simultaneously Disaster Prevention, Relief and Reconstruction**

Love

# Special Act (5 years period)



- **Morakot Typhoon Post-Disaster Reconstruction Special Act** was approved by Congress on August 28 and declared by the President on August 29, 2009. **(20 days after)**
- **The budget** for the reconstruction plan is NT\$ **120 billion** (plus 22 billion from reallocated budget at 20 days) and was declared by the President on Nov. 20, 2009. **(94 days after)**
- The Act is used for the amendment to the **“Disaster Prevention and Protection Law”**.

# Core Spirit of Special Act

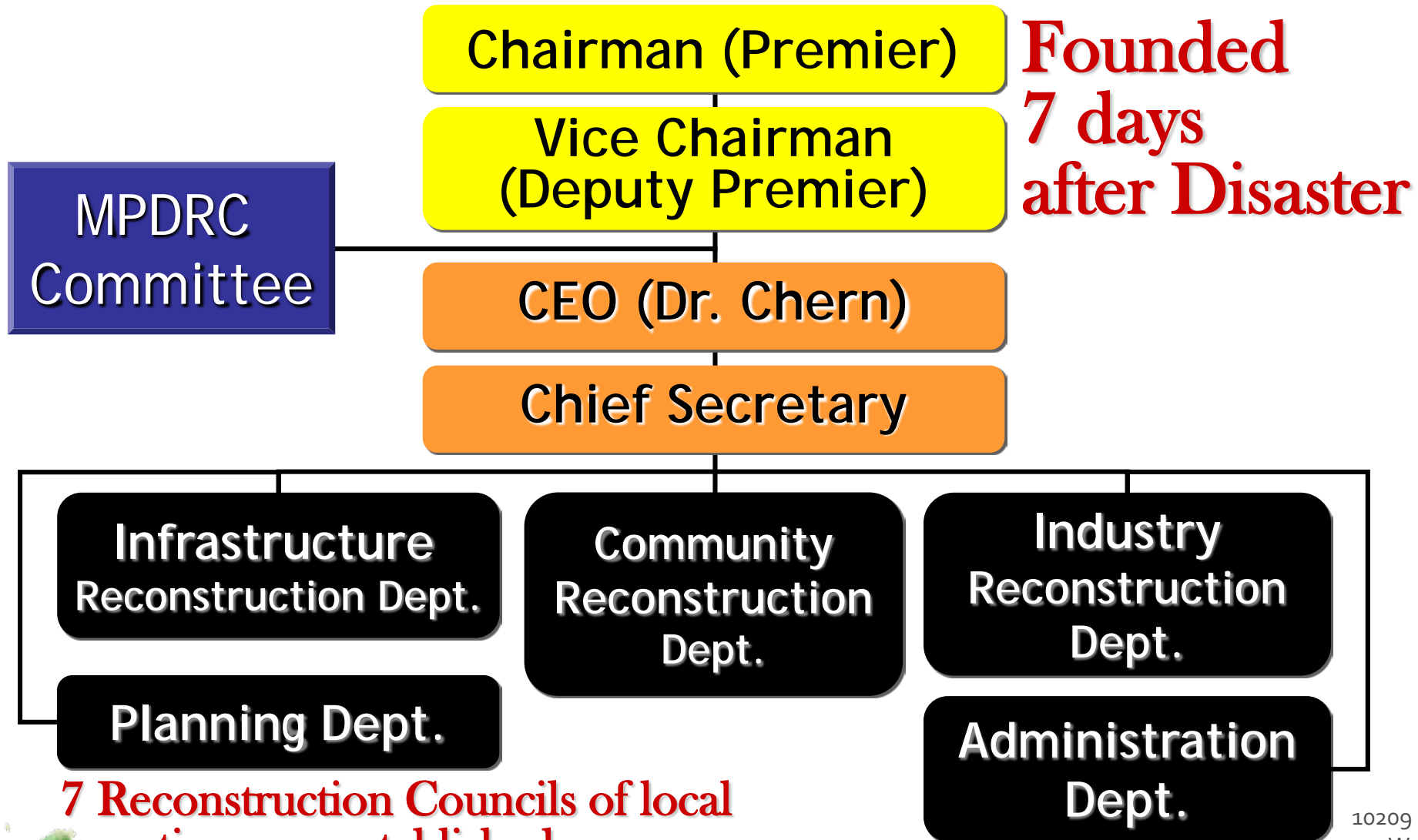


***SAFETY, EFFICIENCY***

## Article I

- This Special Act is duly enacted in an attempt to help proceed with Post-Typhoon Morakot disaster reconstruction in a **safe, effective and prompt manner.**

# Organization of MPDRC



# Public Budget & Donation



Unit: NTD billion

## Public Budget

**138.5 billion NTD**

- Special Budget: 116.5
- Reallocated Budget: 22

## Donation

**25.3 billion NTD**

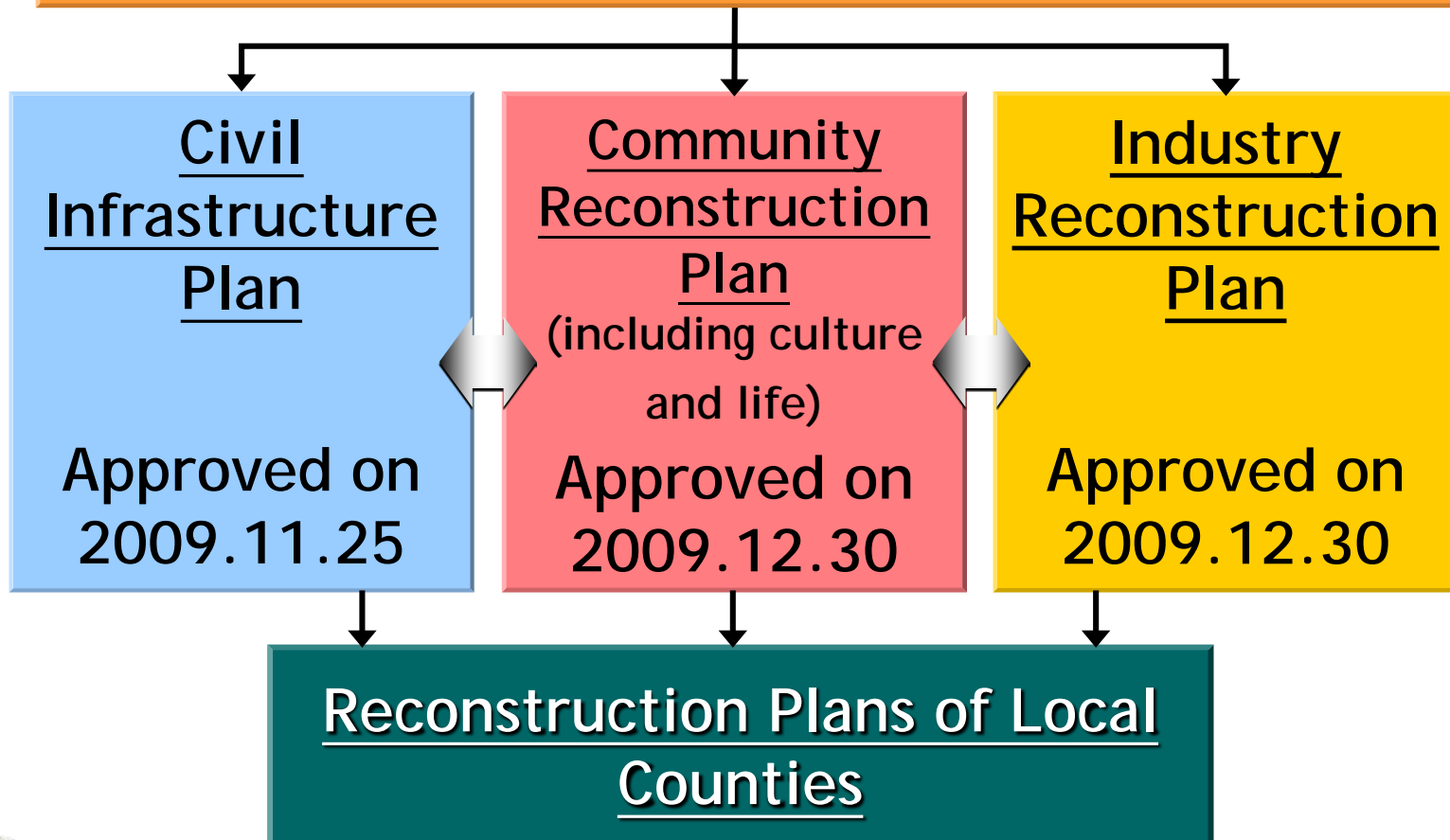
- Tzuchi Foundation: 4.8
- Red Cross R.O.C.: 5.2
- World Vision Taiwan: 1.4
- Others: 13.9

**Total: NT\$163.6b (US\$5.5b)**

# Framework of Reconstruction Plan



Upper Level Guidelines with Land Conservation  
(approved by MDRC on Sept. 6, 2009)



# Core Spirit of Special Act



## ***RESPECT***

### ■ Article 2

The post-disaster reconstruction has to be based on **humanity**, emphasizing the importance of the victims' livelihood, **respect the versatile culture**, assure the community participation, and consider both **national land protection and environmental conservation.**

# Indigenous People in Taiwan



- 16 tribes; 0.51 M people (2% of the total Taiwan's population)...**versatile culture of**



# Respect Indigenous People and Their Culture



## ■ Reconstruction Special Act Articles 1, 2, 4, 15, and 20



# Community Reconstruction Plan



To meet the community demand, participation, culture, and environmental sustainability

Building new schools in the location chosen to be permanent housing site

Indigenous culture and living content

**Strategies  
&  
Principles**

Integrate CSR and new tech., set up new eco- and smart villages

The revival of agricultural villages (infrastructure, community, industry, and social function)

# Strategy of Relocation



- **Emergent Relocation**
- **Intermediate Relocation (military barracks or temporary houses)**
- **Long Term Settlement**
  - Rent Subsidy (1,274 cases approved)
  - Buy house (0.5 M NT\$ & interest/household)
  - Provide free house for permanent stay
- **Reducing the use of shelter houses; providing the permanent houses by NGOs.**

# Safety Assessments & Relocation Principles



- Safety assessment by experts with the participation of inhabitants; discuss to reach consensus with tribe people; declare the special area; limit the habitation and select relocation and relief program.
- Relocation priority
  - moving within the village (離災不離村)
  - moving within the township (離村不離鄉)
  - move to the nearest proper location
- Providing the free house for permanent stay. The house can be inherited but not for sale and renting.

# Confirmation of Safe Locations



- Safety assessment by experts with the participation of inhabitants; **discuss to reach conscious with tribe people; declare the special area;** limit the habitation and select relocation and relief program.
- **291 sites of safety assessment; 115 public hearings for zoning development-restricted areas, 160 site investigations and review meetings**

# Public Hearing about Special Zoning



# Private Participation in Providing the Free Housing



## ■ The construction of permanent house communities by private sectors and NGOs

➤ Tzu-Chi Foundation



➤ Red Cross Society of R.O.C.



➤ World Vision Taiwan



➤ Evergreen group



➤ Dharma Drum Mt.



# Building Permanent Housing



## Central Gov.

Making policies, laws, budgets, land offer, simply administrative procedures, matching resources, major infrastructure construction

## Local Gov.

Qualification review, accept application and complete process, community management

## NGOs & Enterprise

Fund raising, building Local Infrastructure (in collaboration with the central and local Governments)



# The Process of Reconstruction



Emergent  
Evacuation

Short Term  
Allocation

Civil Infrastructure  
Reconstruction

Permanent House  
Construction

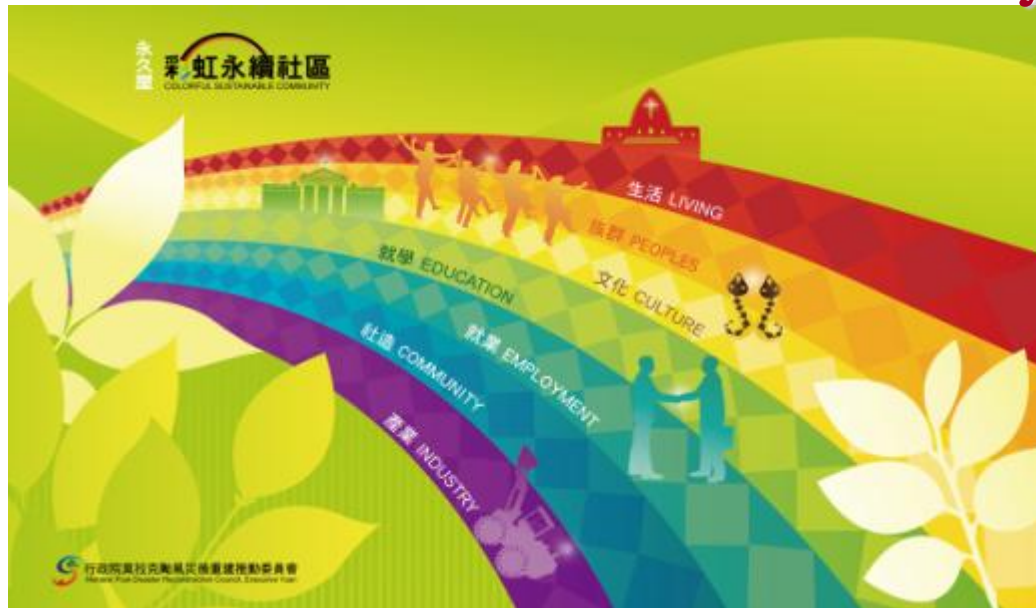
School  
Reconstruction

Cultural  
Reconstruction

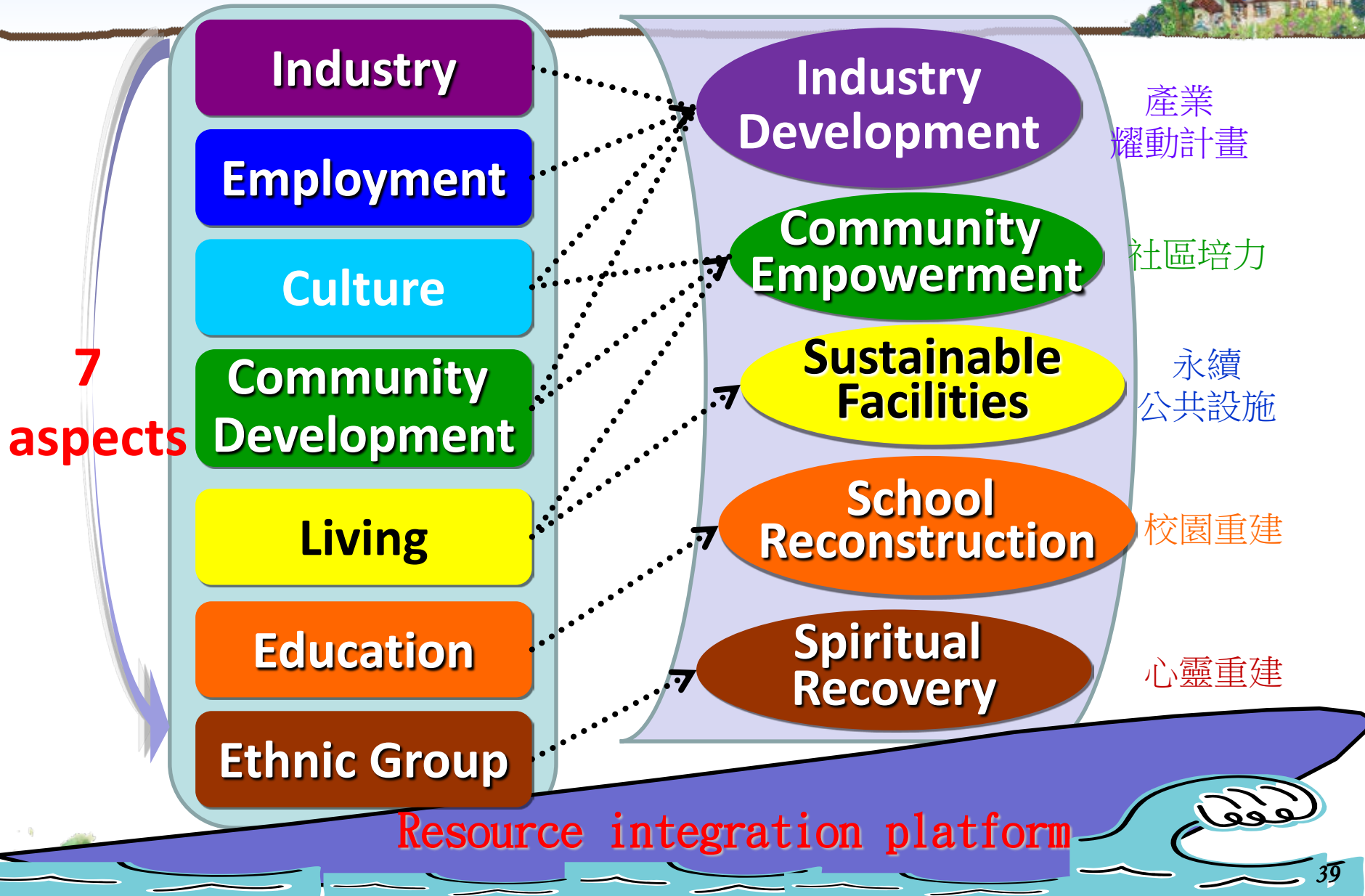
Spiritual  
Reconstruction

Industry  
Reconstruction

Colorful Sustainable Community



# Colorful Sustainable Community



# Innovation: Concept of Sustainable Community



## Organic Development



House

Home

Community

**COLORFUL  
SUSTAINABLE  
COMMUNITY**



# Permanent House Community



- There are total 3,561 permanent houses in 43 sites for relocation.



Constructed by Taiwan World Vision (2010.12.25 completed)

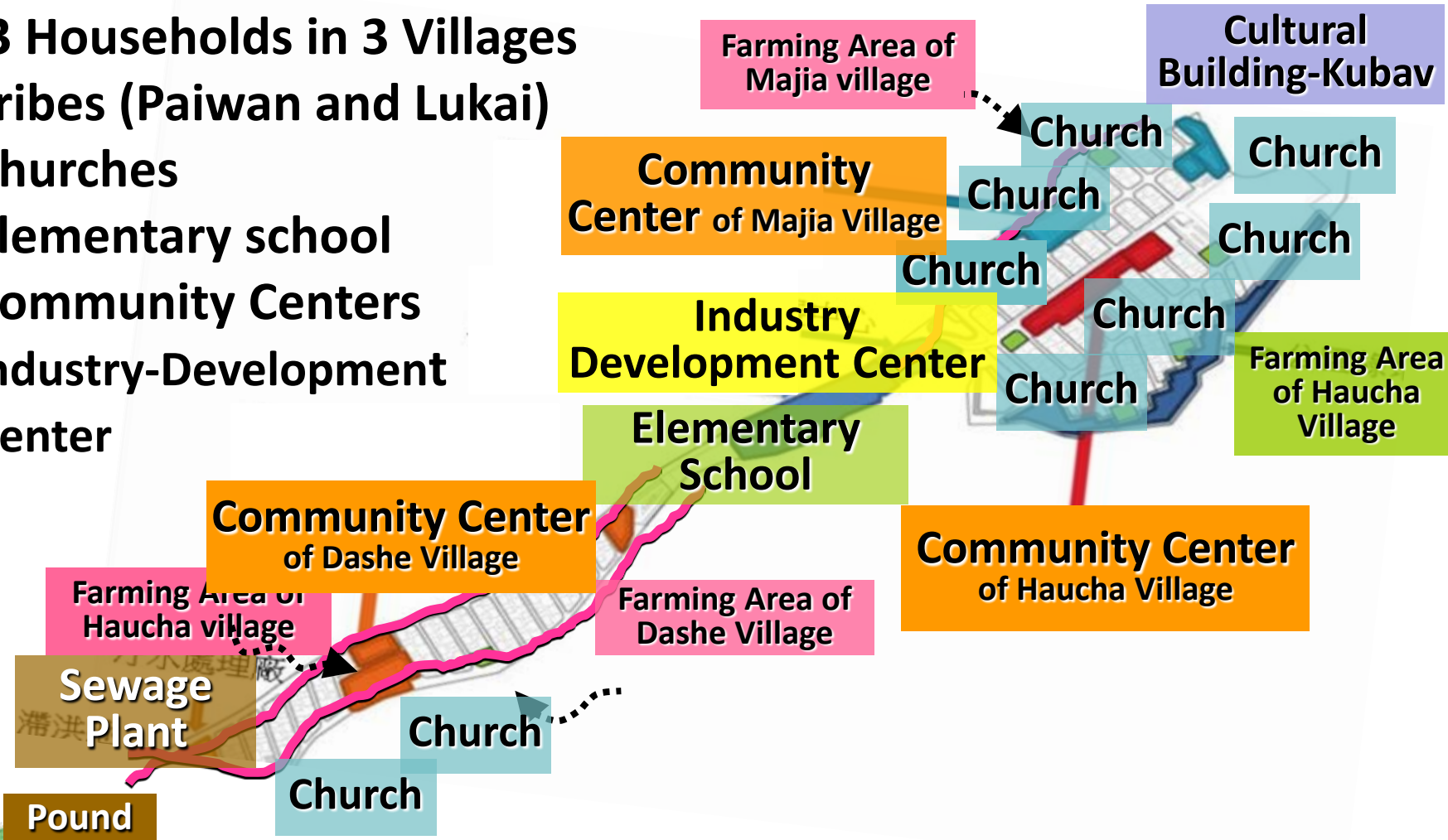


# Layout of a Sustainable Community



## The Rinari Community

- 483 Households in 3 Villages
- 2 Tribes (Paiwan and Lukai)
- 9 Churches
- 1 elementary school
- 3 Community Centers
- 1 Industry-Development Center



# Permanent Housing (Kaohsiung County)

The Lo Lo Community



The Xaolin Community



The Da Ai Community



# Permanent Housing (Pingtung County)



# Respect the Autonomy of Every Displaced Family

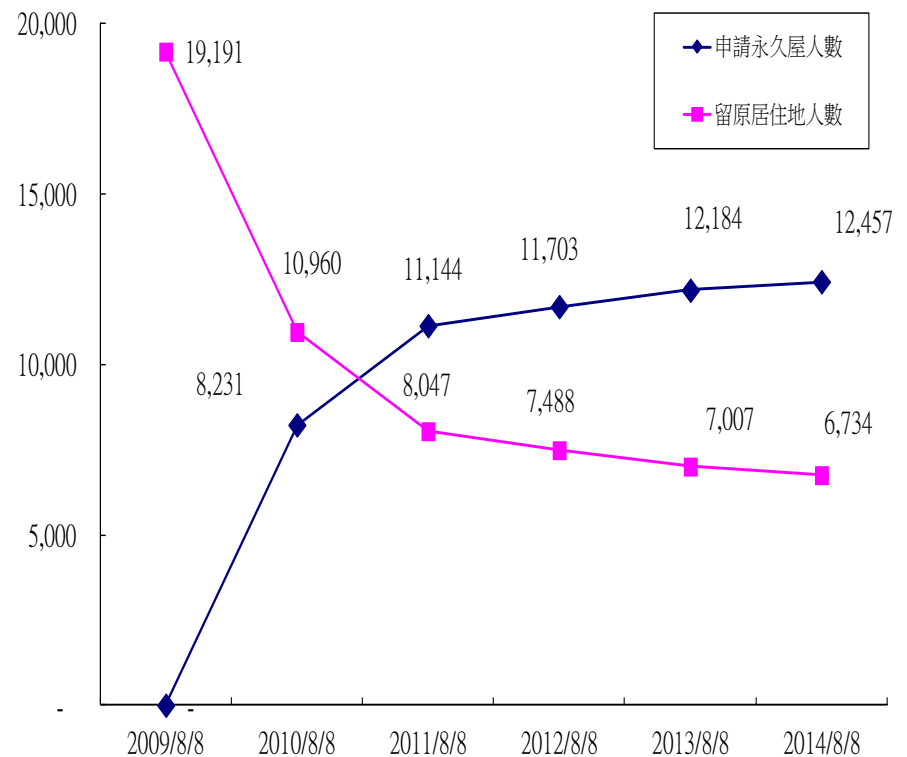


## ■ Under safety premises & relocation priority :

**43 Relocated sites :**

- within the village 15**
- within the township 9**
- nearest location 19**

“No one is forced  
to leave”



# School Reconstruction



- 1,426 schools were damaged and in need of repair.
- 16 schools have to be reconstructed, and all complete by this year.
- All the students were relocated to other proper places for schooling during the reconstructed period.



Mintzu Elem. School,  
Kaohsiung



Laiyi Elem. School, Pingtung



Taiwu Elem. School, Pingtung

# Taiwu Elementary School

Constructed by the BENQ Foundation (9.28.2011 completed)



features the Paiwan tribe culture



# Evergreen Lily Elem. Pintong

Constructed by Chang Yung-Fa Foundation (2012.5.18 completed)



# Community Facilities



Da-Ai Community Center, Kaohsiung



Ninari Community Commercial Center, Pintong



Hi-Life convenient Store in Da-Ai Community, Kaohsiung



Churu Community Center, Chiayi

# Cultural Messages



**Rinari - newly constructed**



**After settlement**



# Cultural Messages



Lily village – newly constructed



After settlement



# Cultural Facilities



**The Xiaolin Village Memorial Park was built near the Xiaolin Village, which was buried by landslide during Typhoon Morakot, which killed 462 people.**



**The Xiaolin Village Memorial Park**



# Cultural Facilities & Festivals



**Xiaolin Pinpu tribe museum**



**Xiaolin Pinpu tribe Konkai(公廨)**

**Night Festival**



# Spiritual & Cultural



- 26 Living Reconstruction Service Centers & 39 Culture Community Service Points
- Provide service of **664,982** persons



高雄那瑪夏區生活重建服務中心



台南南化區生活重建服務中心

# Civil Infrastructure Reconstruction (Innovative Approach)

The reconstruction of roads & bridges, levees and embankments, flood control and mountain slope stabilization based on the **land conservation principles** and **comprehensive management of river basin**.

# Dredging of Rivers



- 285 million m<sup>3</sup> in 2013/3/31, neck by neck of truck's length reaches 9.5 cycles of earth



# The Benefit of Dredging Action



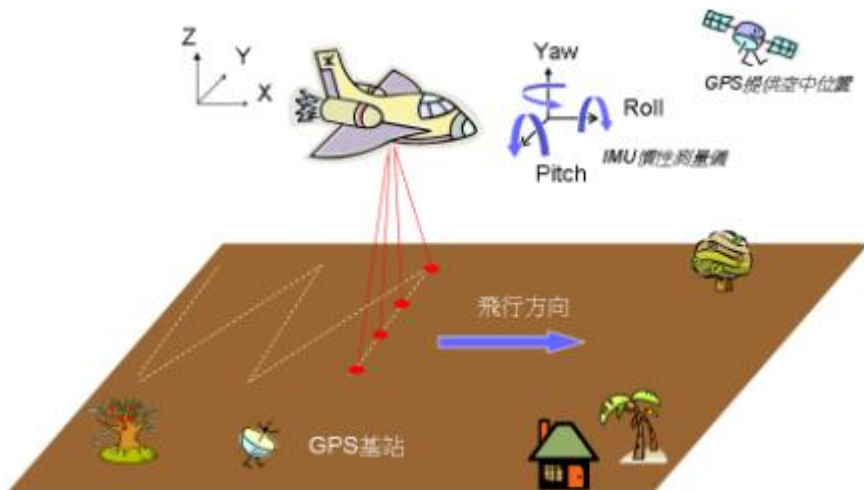
<b>River System</b>	<b>Length of Dredging (km)</b>	<b>Increase of Flowing Area (m<sup>2</sup>)</b>
<b>Tzoutzei river</b>	<b>57</b>	<b>172</b>
<b>Kao-Ping river</b>	<b>55</b>	<b>406</b>
<b>Other rivers</b>	<b>76</b>	<b>143</b>

After the attack of 4 waves of monsoon rains during May and June, heavy showers on July 27, 2010, and five past typhoons, the past heavy flooded areas, Linbian and Chishan, have no major flooding damages.

# Use of New Technologies for Reconstruction (Innovation)



Use of **Lidar and Aerial Photography** to detect the high risk deep layer collapse area for the protection of tribal village by warning and evacuation mechanism and to develop reconstruction guideline.



# Roads and Bridges



- Complete 849 construction projects , including 126 new bridges (long span, high pier, deep pile, bypass unsafe zone )



Wutai-Kuchuan Bridge, Pintung



Delerzuga Bridge, Kaohsiung

# Roads and Bridges



■ **Three stages to provide safer and needed transportation:**  
temporary culvert bridge, elevated steel bridge, and permanent large span bridge



高132線多納橋竣工



台24線霧台谷川大橋竣工

20140817 從莫拉克颱風災後重建看見永續與創新

# New Bridge in Mountain



## Wutai-Kuchuan Bridge

New bridge 654m long , 12.3 times longer than old one,  
99m high pier



# Bridge Design Concept



Long span steel truss bridge  
(拉冷冷橋)



Avoid the unstable geology site  
(芙谷峩橋, Alishan)



Deep foundation and larger span  
(綠茂橋)



2013/08/20

# New Bridge in Mountain



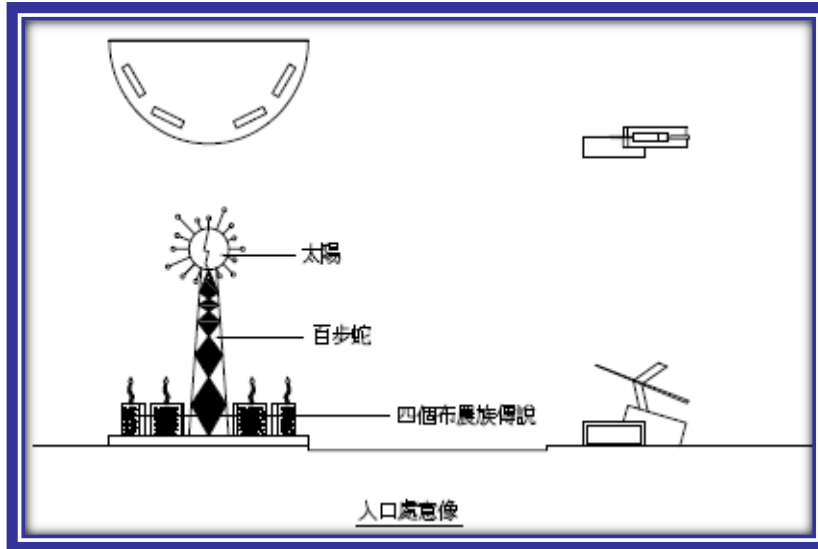
## Dong-Pu Sun Moon Twin Bridge

Bypass the attack face of collapsed road bed

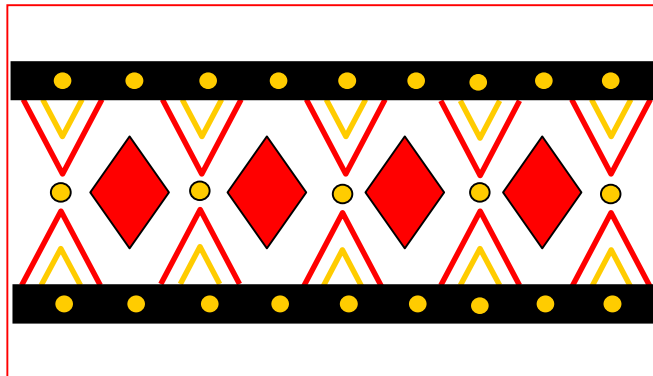


0140  
17 從  
莫拉  
克颱  
風災  
後重  
建看  
見永  
賣與  
創新

# Sun-Moon Twin Bridge



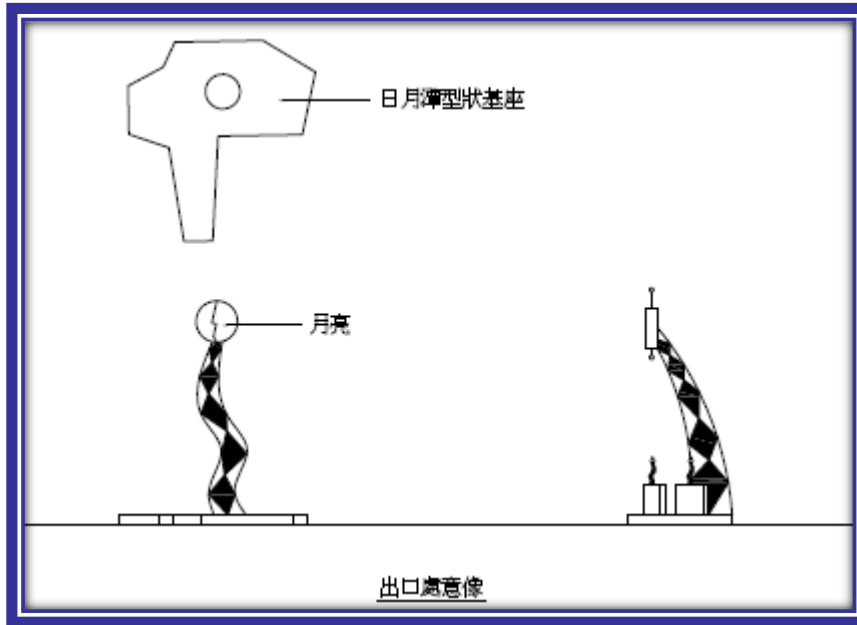
Symbol of Sun & Bow



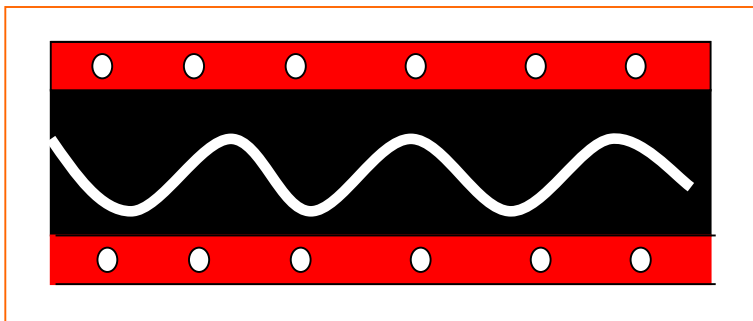
Symbol of Male



# Sun-Moon Twin Bridge



Symbol of Moon



Symbol of Female



# Saviki Bridge with Cultural Totem



# Valley Glaze Bridge



A 262 m suspension bridge with culture features in support of the tourism industry of dislocated community(262m)

## 屏東縣山川琉璃吊橋



中華電信 下午6:12 41%

<https://m.facebook.com/>

#不開車不塞車遊玩最爽快  
#琉璃吊橋預約通道快速通關不與散客排隊人擠人

### 探訪原鄉部落之旅

**琉璃套票 649元** 含：原鄉一日遊、琉璃吊橋門票、原鄉風味餐、原鄉土產、原鄉紀念品

**禮納里套票 949元** 含：原鄉一日遊、琉璃吊橋門票、禮納里部落風味餐、原鄉土產、原鄉紀念品

**購買方式**  
原鄉部落網站、原鄉旅行社網站

**注意事項**  
原鄉部落數量有限



12/26免費開放三個月  
三地門~山川琉璃吊橋

# Mental Health & Spiritual Recovery



- Various attempts were made to mitigate the post-disaster trauma.
- Various sources of mental support were available to the victims to sustain their mental health, either from **religious groups, art therapy, or from social workers.**



# Church & Spiritual Farm



Farm land for Old People



禮納里好茶天主堂



禮納里好茶長老會



禮納里瑪家安息日會

# Community & Industrial Reconstruction

Working Together among  
Government, NGOs &  
Enterprises

# Industrial Goal & Action



- Promote green energy and technologies of ubiquitous, computing and humanity for creating employment opportunities in coordination with **innovation of arts, green energy, high quality agriculture, leisure tourism and industries of local characteristics.**

# Participation & Intergration



- **Private Participation by Enterprisers and NGOs.**
- **Integrate the hardware and software; establish the sale & distribution system.**
- **Develop the industry with features of versatility and local characters ,and arts innovation of indigenous people.**
- **Adopt FOXCONN Co.'s **BOPT (Build-Operate-Profit-Transfer) approach** to ensure the long term employment of refugees**

# Private Participation



- **A village a recovery plan** – Indigenous villages (culture, industry, living etc)
- More than **31 industries & NGOs**, including Foxconn, TSMS, UMC & China Steel Corp etc., have participated in the industry recovery plan.
- Social enterprise (Xiaolin Village)



# Yonglin Organic Farm



- Create the industry by joining ecology, living and production together and developed the tourism business with the neighboring area.
- Create the international model of Disaster Refugee Relocation, job placement, and new enterprise development by BOPT  
(Built-Operate-Profit-Transfer).



# BOPT Model - Yonglin Farm



- Foxconn invested \$500 million NTD to build a organic farm and hire refugees.
- The ownership of farm will be transferred to the Kaohsiung City government after six years' management.
- Land area: 166 ha.



# Yonglin Shanlin Organic Farm



# Industry Development of Li-Chia Village by TSMC



- TSMC Typhoon Morakot Relief Project
- **Built-Develop-Transfer** **BDT Mode**
- **Compound Management** by joining Bamboo Plant, tea plant, civilian hotel, and tourism.



New Logo

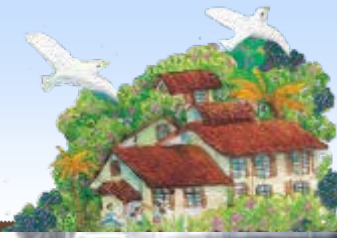


Tea Plant



Bamboo Plant

# Business Sector Assistance



Tea Plant and Bamboo Plant by TSMC



Wood Studio by Chant Oil Co.



Sustainable Living Project by China Steel Co.

# Developing Local Industry



- The development of indigenous industry stagnated as a result of the unstable transportation condition.
- Government introduced professionals to provide technology service and consultant operation to help recover indigenous industry.



# Photovoltaic Farming in High Degree Subsidence Area (Pingtung)



## ■ Innovation: Land Conservation & Social Assistance

- Assist at least 168 suffered families in obtaining new sources of income
- Reduce groundwater extraction at high degree subsidence area (fish ponds).
- Increase renewable energy (28.5 GWh in 2012)
- Create 5,400 jobs



# Social Enterprise (Innovation)



- Xiaolin village victims & Mr. Chien (Allion Labs, Inc.) co-founded the “2021 Social Enterprise” on Aug. 7, 2013.
- Develop a plum product chain using naturally-grown native organic plums.



# Achievements (since 2009)

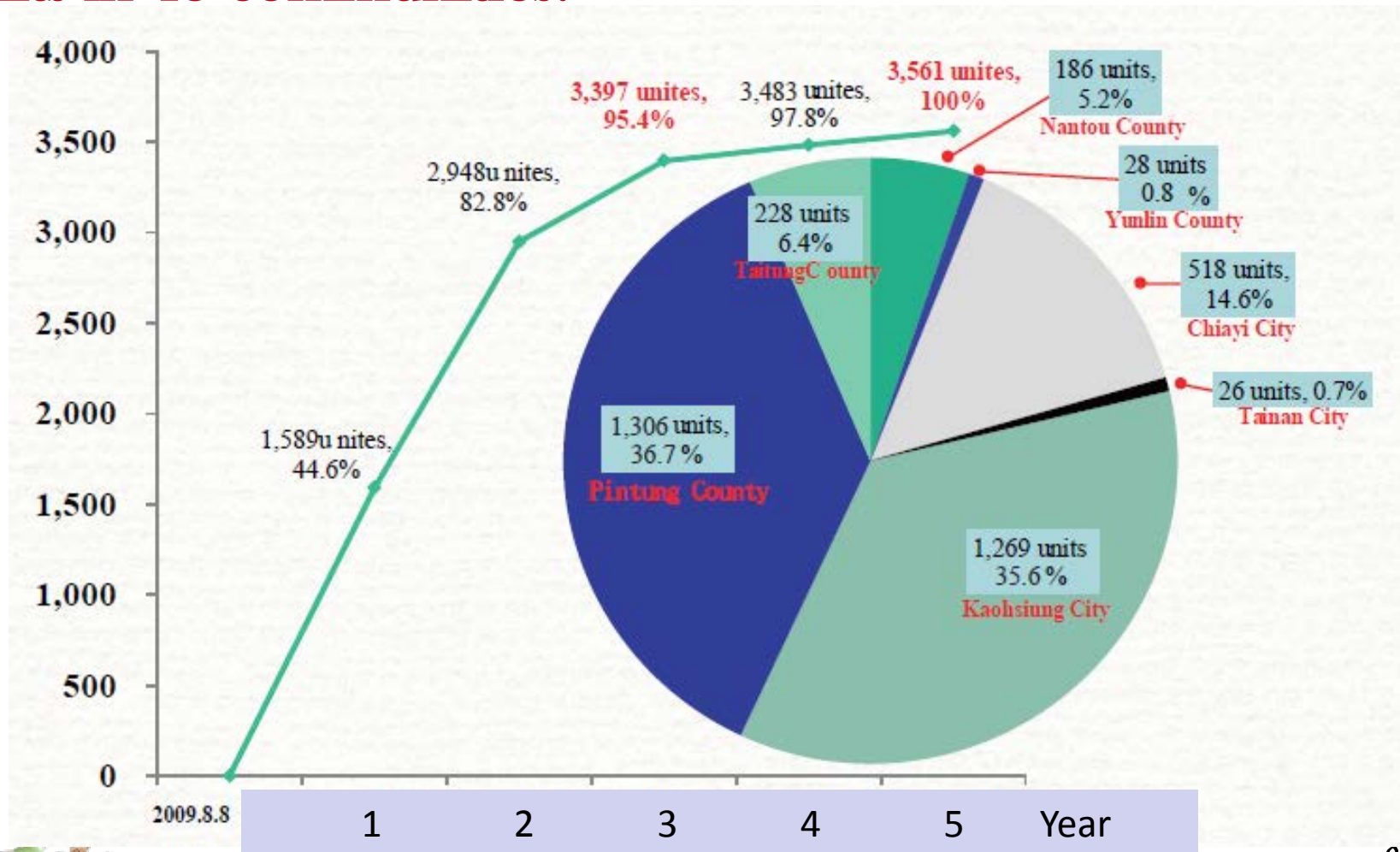


- **Civil Infrastructure** (129 new bridges and others) :  
No loss of built permanent structures
- **Live & Property:** No major Casualties & property loss in the subsequent typhoons & heavy showers
- **Tourism & Economy:** Improved
- **Psychology:** Suicide rate decreased
- **Opinion Survey:** Satisfaction shown in relocated Communities

# Number of Relocated Houses Built by Year (2009 -2014/8)



Fast and well planned construction — 3561 house units in 43 communities.



# Policy Strengthened



- Taiwan has further revised the “**Disaster Prevention & Protection Act**” on August 5, 2010. An office led by Premier level was founded & The rescue action becomes the regular mission of the military units.
- Placement of military units ahead of feasible disaster. **Treat and prepare every typhoon as Typhoon Morakot.**
- Clarify the role and obligation between **central and local government.**

# Taiwan's Experience & Actions facing Disasters



- Disaster prevention is more important than disaster relief; avoidance of disaster is better than prevention of disaster
- When we encounter the enemy (disasters), we must anticipate prepare for the worst, dispose in advance, deploy troops beforehand, and ensure readiness for immediate rescue operations

# Withdraw Actions in Recent Typhoons



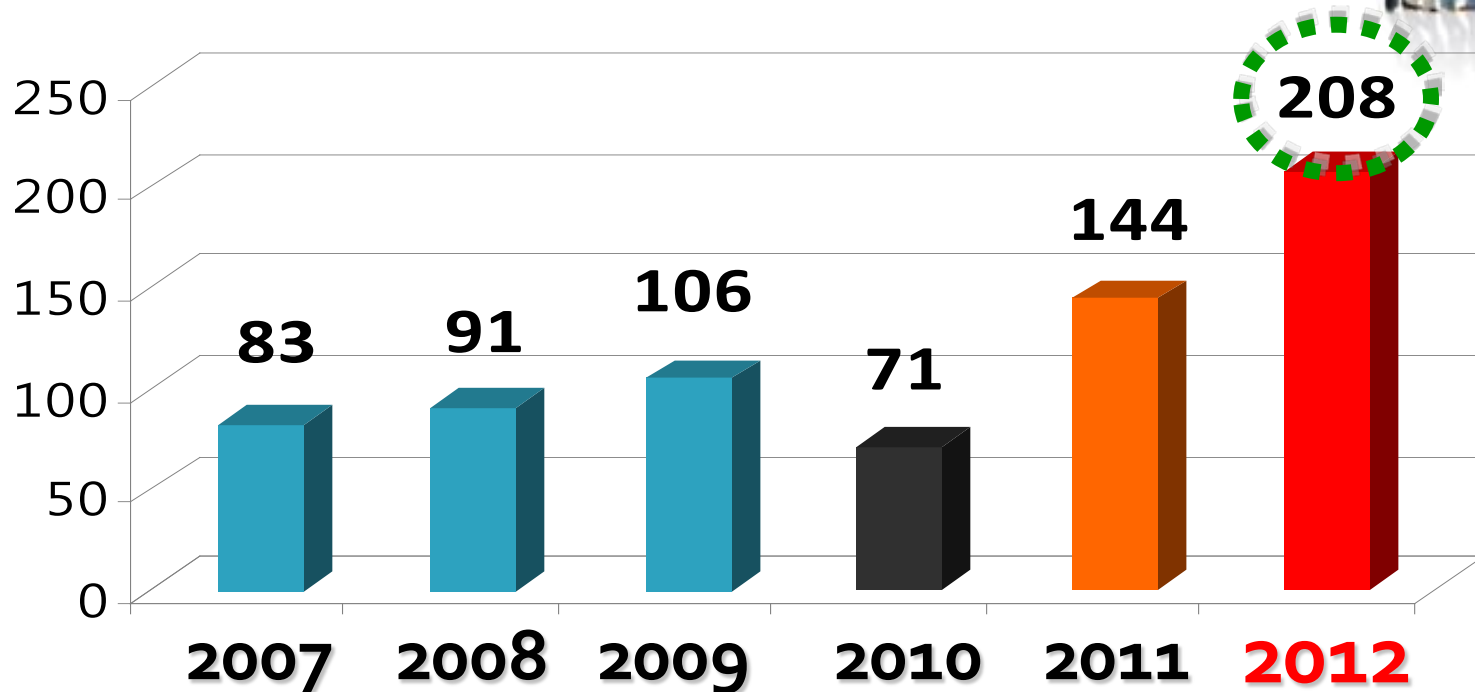
- Due to early withdrawals, almost nobody got hurt or died in Morakot Disaster Areas. (2009 – 2017)

Typhoon	No. of withdrawals	Death or injured	Morakot Serious Disaster Areas
Typhoon Lionrock (2010/9/1)	1,891	none	None
Typhoon Meranti (2010/9/10)	919	none	None
Typhoon Fanapi (2010/9/19)	16,584	2 dead & 111 injured	2 dead & 6 injured (not in serious area)
Typhoon Megi (2010/10/21)	3,453	15 dead (I-Lan)	None
Typhoon Talim (2012/6/19)	9,071	1 dead	None
Typhoon Soulik (2013/7/11)	8,576	2 dead & 123 injured	None

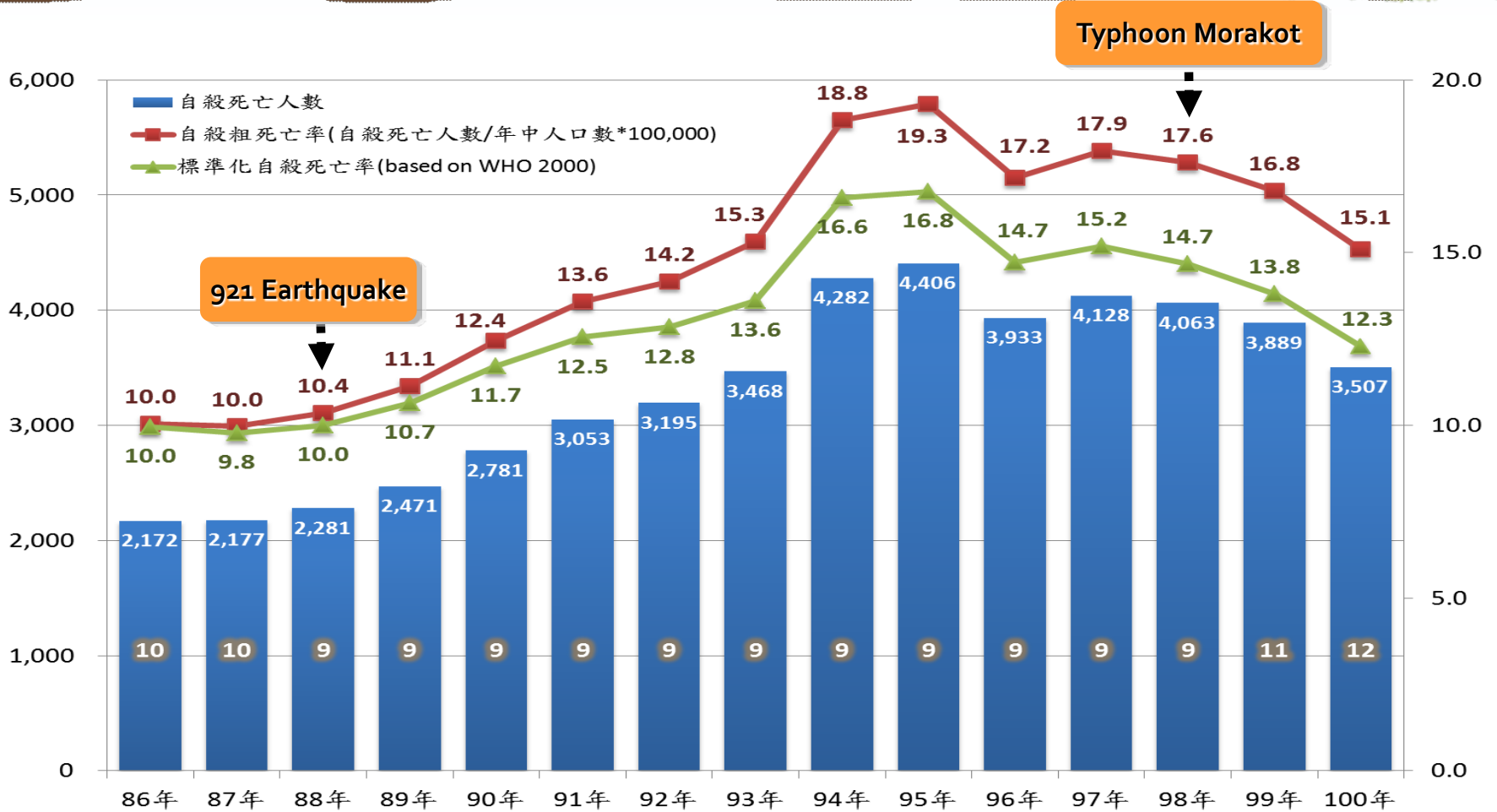
# Alishan Revitalization



- After reconstruction, the number of tourists to Alishan Forrest Park has amounted to 2.08 m man-trip, as the highest ever.



# Suicide Rates on the Decrease for the Past 3 Years



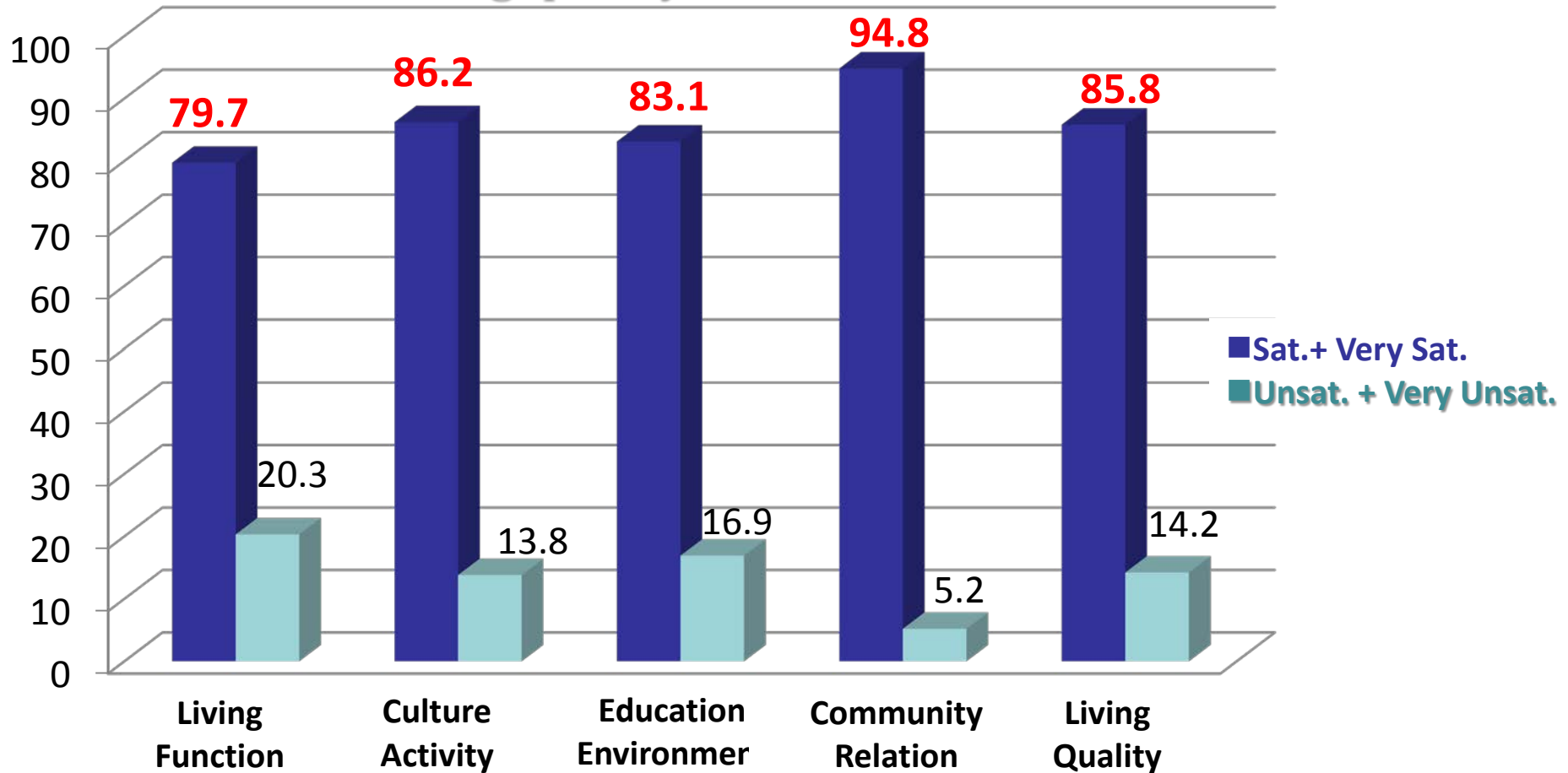
■ In 2011, the total number of suicide deaths was 3,507; the standardized mortality ratio (SMR) was the lowest for the past 10 years.

■ The rank of suicide has gradually dropped in the rankings of the causes of death.

# Survey of Satisfaction in Permanent Houses



All items about living quality with satisfaction exceed 80%



By Dept. of Social Work, National Pingtung Univ. of Science & Technology, 2014

# Not only Reconstruction... is Reborn



Safety  
Humanity  
Innovation...  
& Sustainability



# A Model of Reconstruction



- In the face of the impact of climate change and in pursuit of sustainable development, Taiwan has constructed a **Social Management System** with a high degree of disaster prevention awareness and fast reconstruction capabilities.
- This is a join efforts of **Government, NGOs, Charity Organizations, and enterprises**; and with the own efforts of **refugees** after the **Disaster**.

# Taiwan's Experience



- With regard to the environment of the disaster areas and public facilities, the government has strengthened the mechanism of **warning, evacuation, and rescue** under the disaster prevention and protection policy of **“Forecasting all scenarios and preparing for the worst”** to evacuate residents temporarily in possible disaster areas to avoid losses of lives and property.

# Taiwan's Experience of facing Disasters



- Disaster prevention is more important than disaster relief; avoidance of disaster is better than prevention of disaster
- When it comes to fighting enemies (disasters), we must anticipate the most, prepare for the worst, dispose in advance, deploy troops beforehand, and ensure readiness for immediate rescue operations

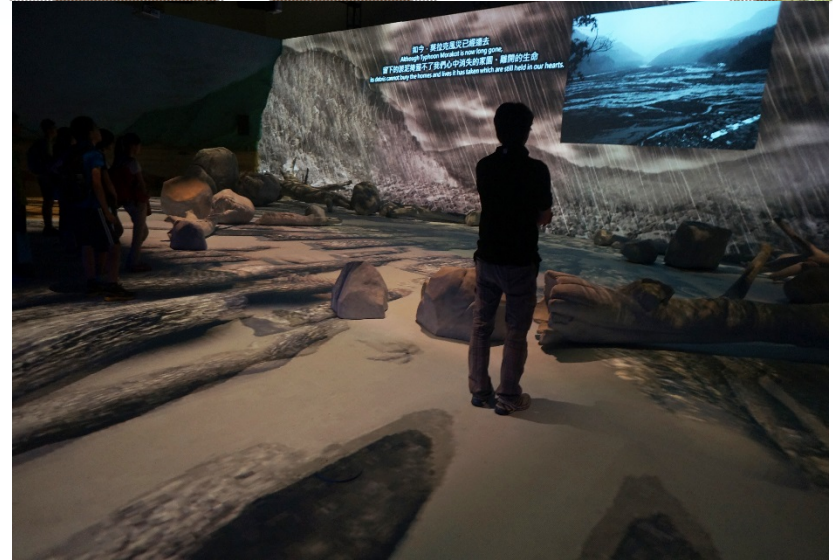
# What We Have to...



- The Typhoon Morakot post-disaster reconstruction experience reveals that that the cooperation and **integration of national and international efforts** are necessary for better preparation to face the future mega-disaster challenge.

# Morakot Reconstruction Exhibition Hall

## Kaohsiung





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