Second European Symposium on
Water Technology & Management

20-21 November 2013
Leuven, Belgium

Water Challenges and Climate Change Adaptation in Taiwan - Taking example of Kaohsiung

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Water Resources Research Center

NSYSU, Kaohsiung, Taiwan


China
Matsu
Taipei
Kinmen
Taiwan
Penghu
(Pascadores)
Kaohsiung
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Google


Kaohsiung


Kaohsiung 1935

Kaohsiung,
a harbor city, an industrial city, and a river city

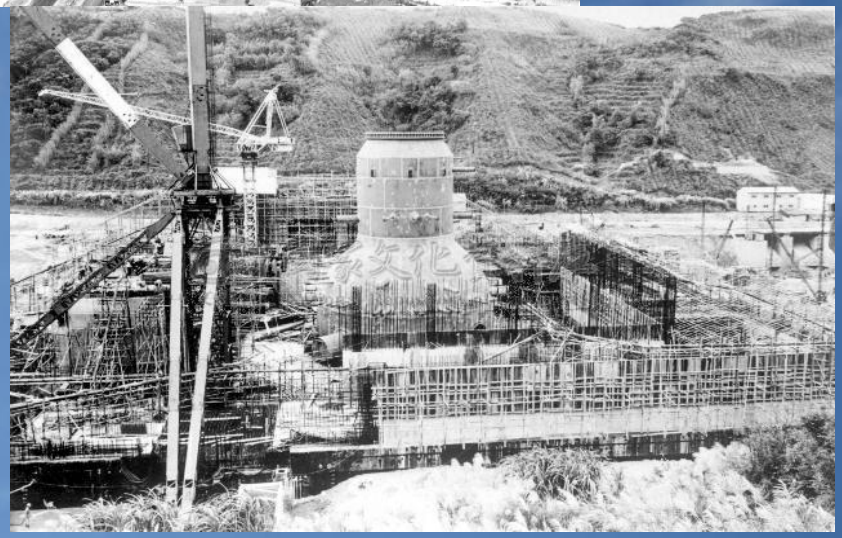





Image: 高雄市政府 Kaohsiung City Government

Kaohsiung has its past …

10 major infrastructure constructions, 70s

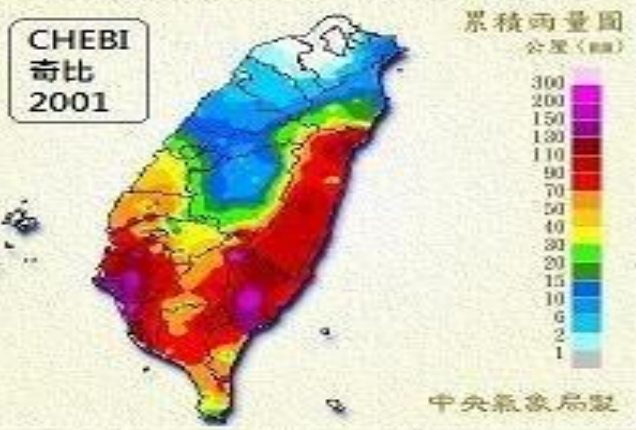


Kaohsiung, the Ocean Capital of Taiwan

When developments facing EXTREME weather

6/23 00:00 至 6/23 20:00

CHEBI
奇比
2001



8/04 00:00 至 8/04 20:00

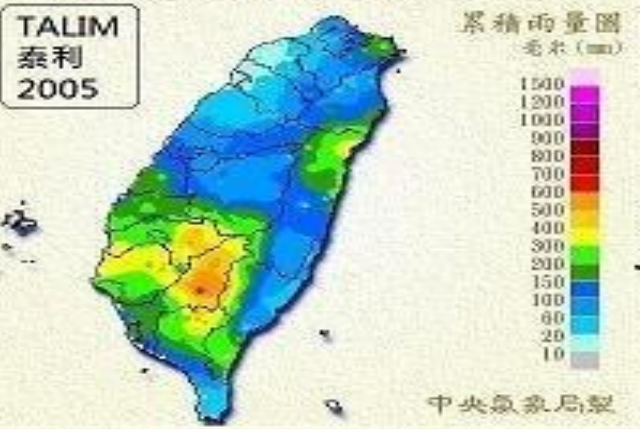
MORAKOT
莫拉克
2003

7/20 00:00 至 7/20 20:00

HAITANG
海棠
2005

9/01 00:00 至 9/01 20:00

TALIM
泰利
2005



7/08 00:00 ～ 7/08 20:00

2006艾維尼
(EWINIAR)

7/29 00:00 ～ 7/29 20:00

2008鳳凰
(FUNGWONG)

9/29 00:00 ～ 9/29 20:00

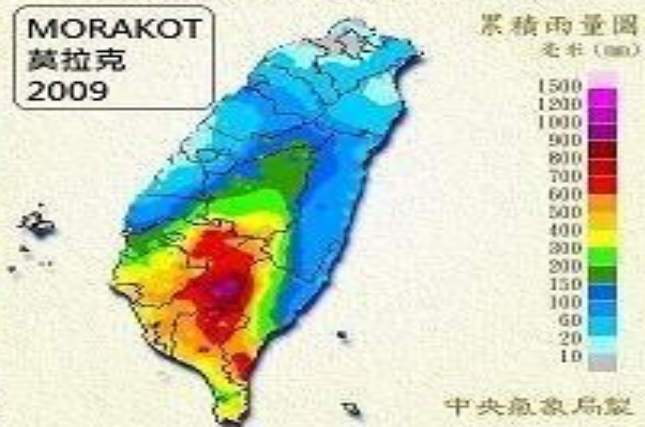
2008薔蜜
(JANGMI)

7/17 00:00 ～ 7/17 20:00

2008卡玫基
(KALMAEGI)

8/08 00:00 至 8/08 20:00

MORAKOT
莫拉克
2009



City at downstream

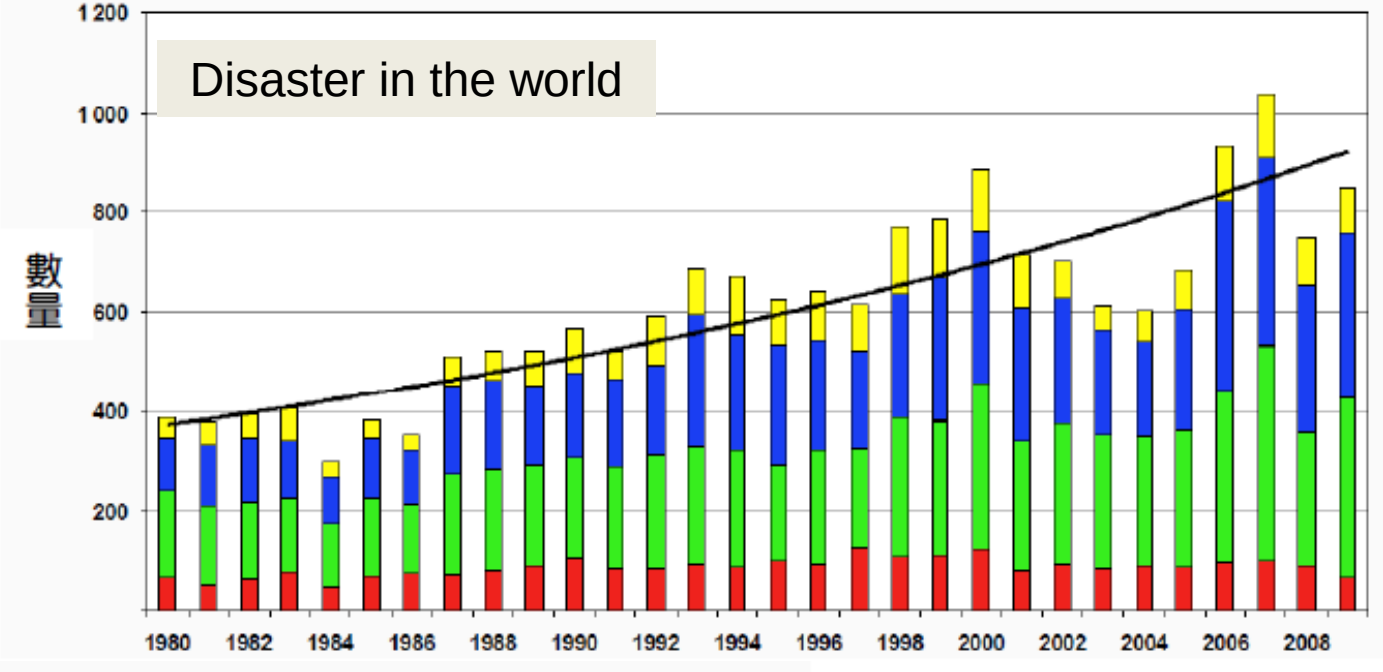
Fanapi typhoon 2010 in Kaohsiung

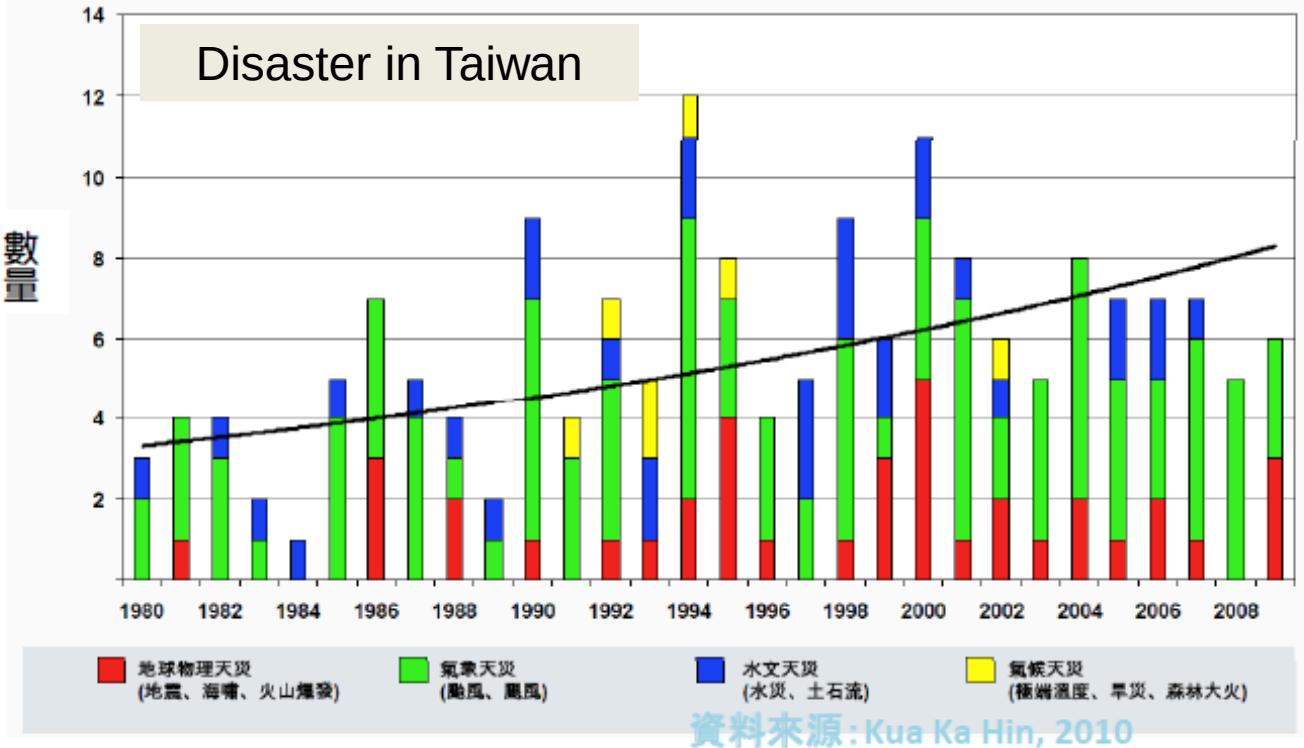
Xiaolin Village
Typhoon Morakot 2009-08-08

Before

After

It's a GLOBAL challenge!





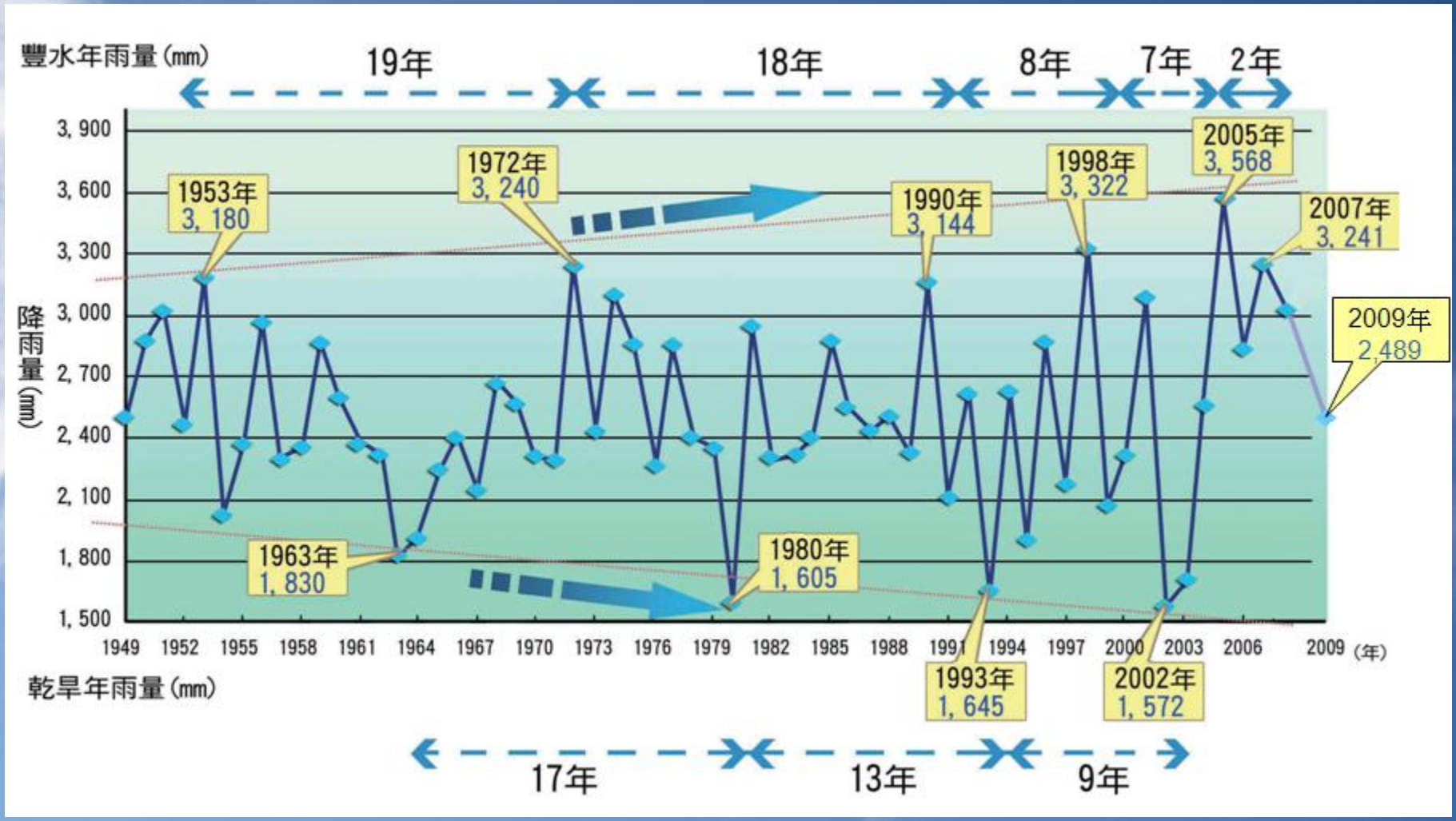
資料來源：Kua Ka Hin, 2010

Taiwan is not the only one to face the challenge.

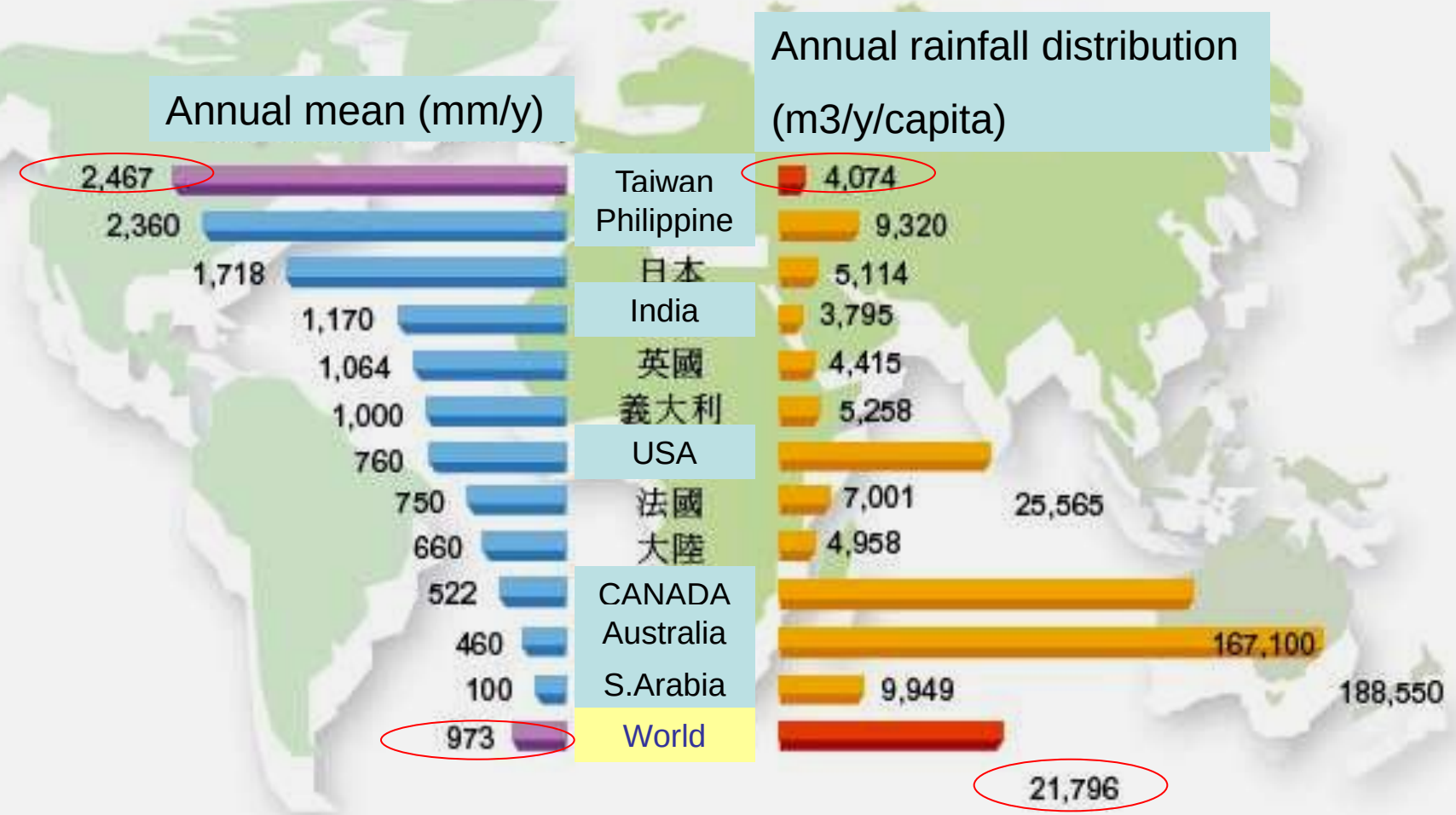
Water Challenges in Taiwan

- Flood and Drought
- Landslide
- Sea-level Rise
- Storm Surges
- Waves
- Adaptation strategies

Droughts and Floods



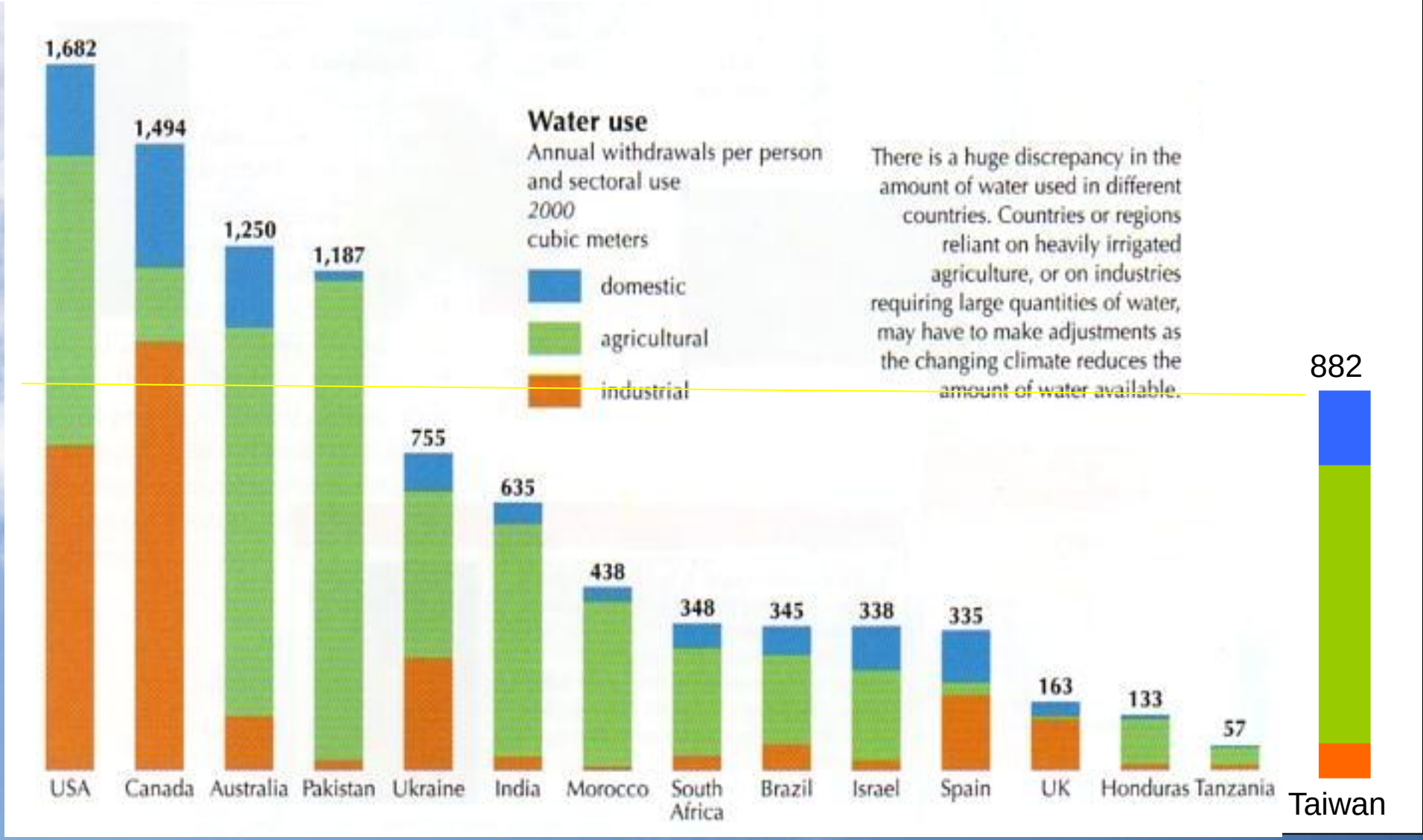
Comparison of Precipitation Distribution



Annual average rainfall in Taiwan is 2.6 times of the world

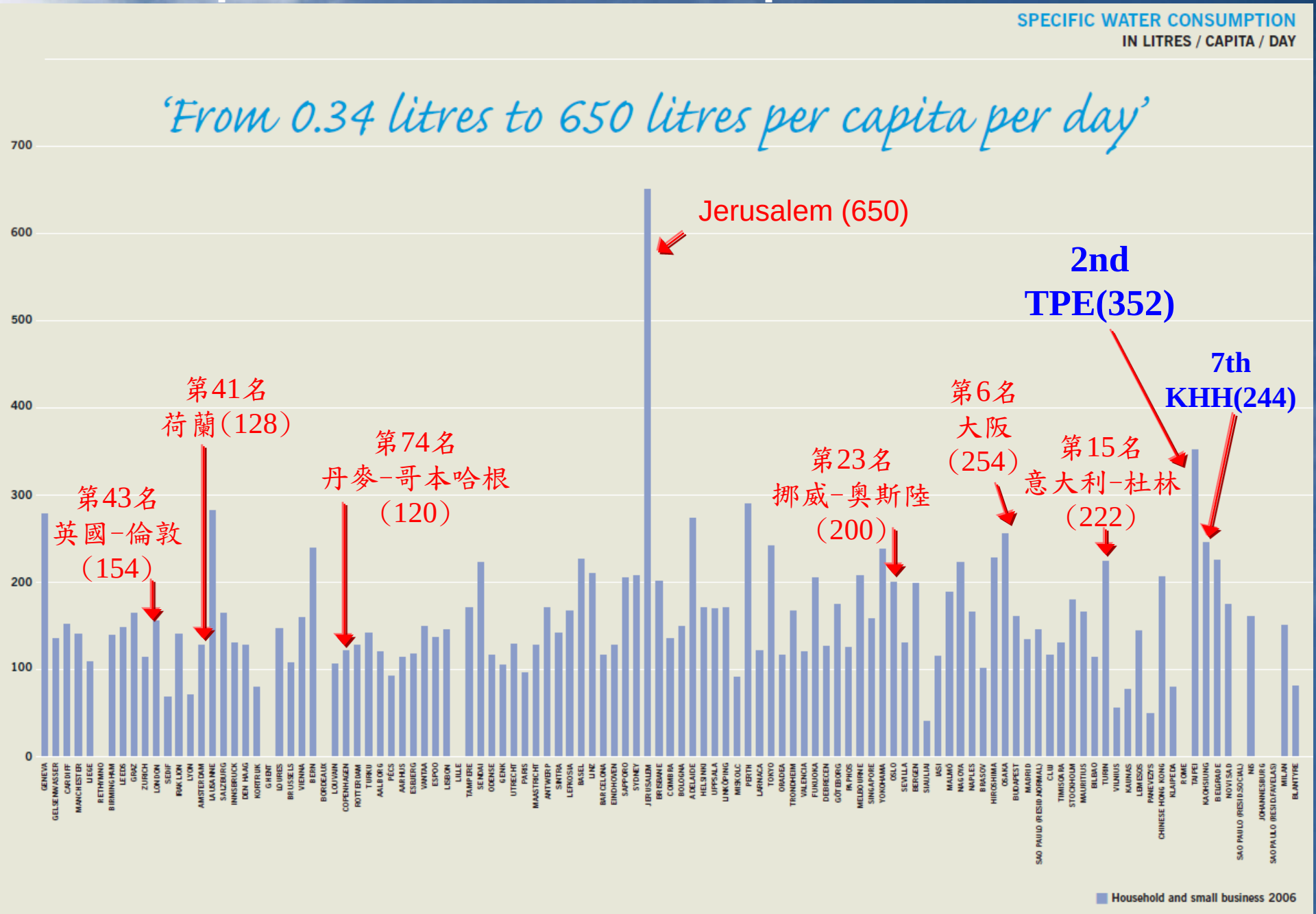
Due to high population density, only 1/5 of the world average，can be distributed to each person

Water use



WRA (2006)

Specific water consumption (IWA, 2008)



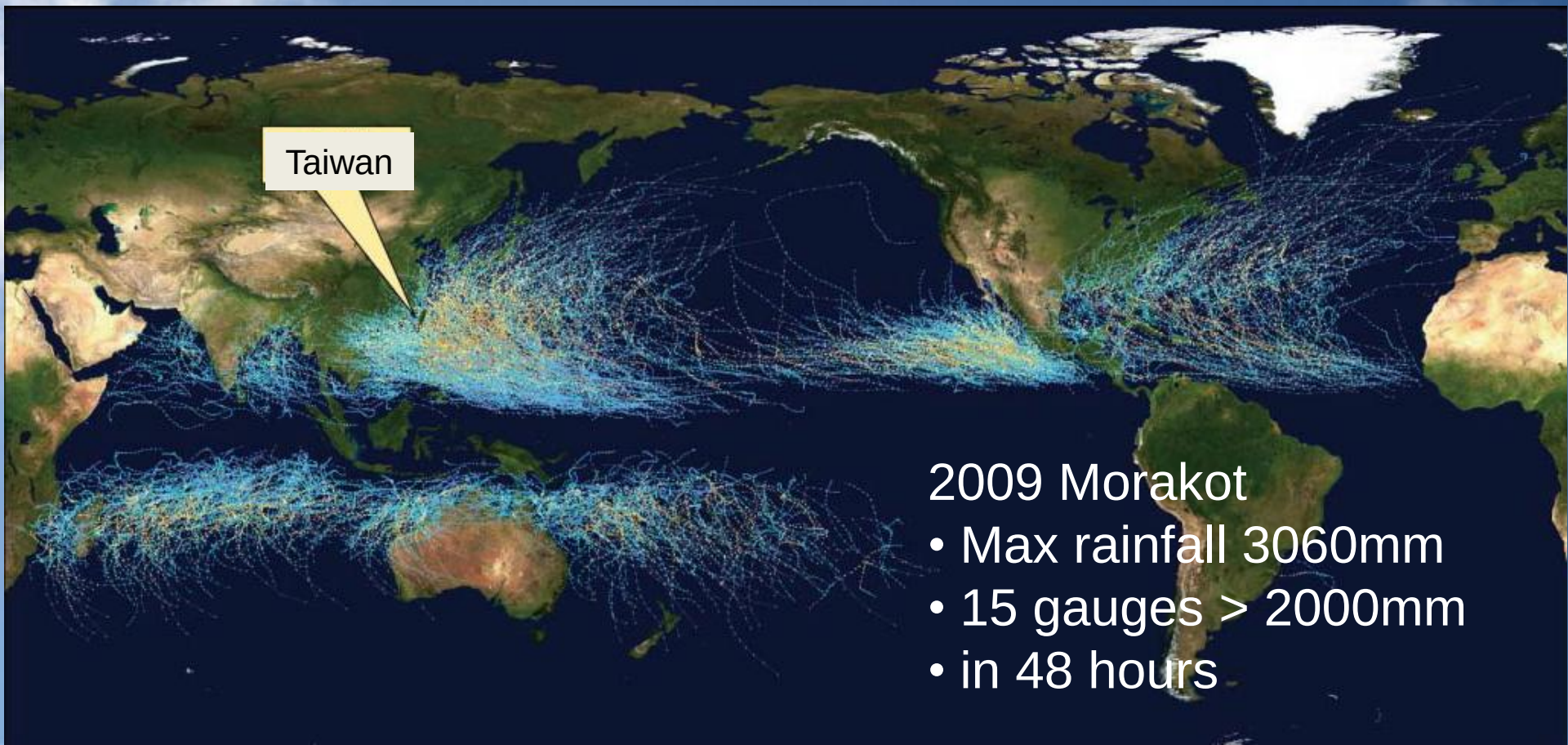
Deserted Reservoir

Drought is definitely an important issue

on future challenges!

1985-2005 Storm Tracks

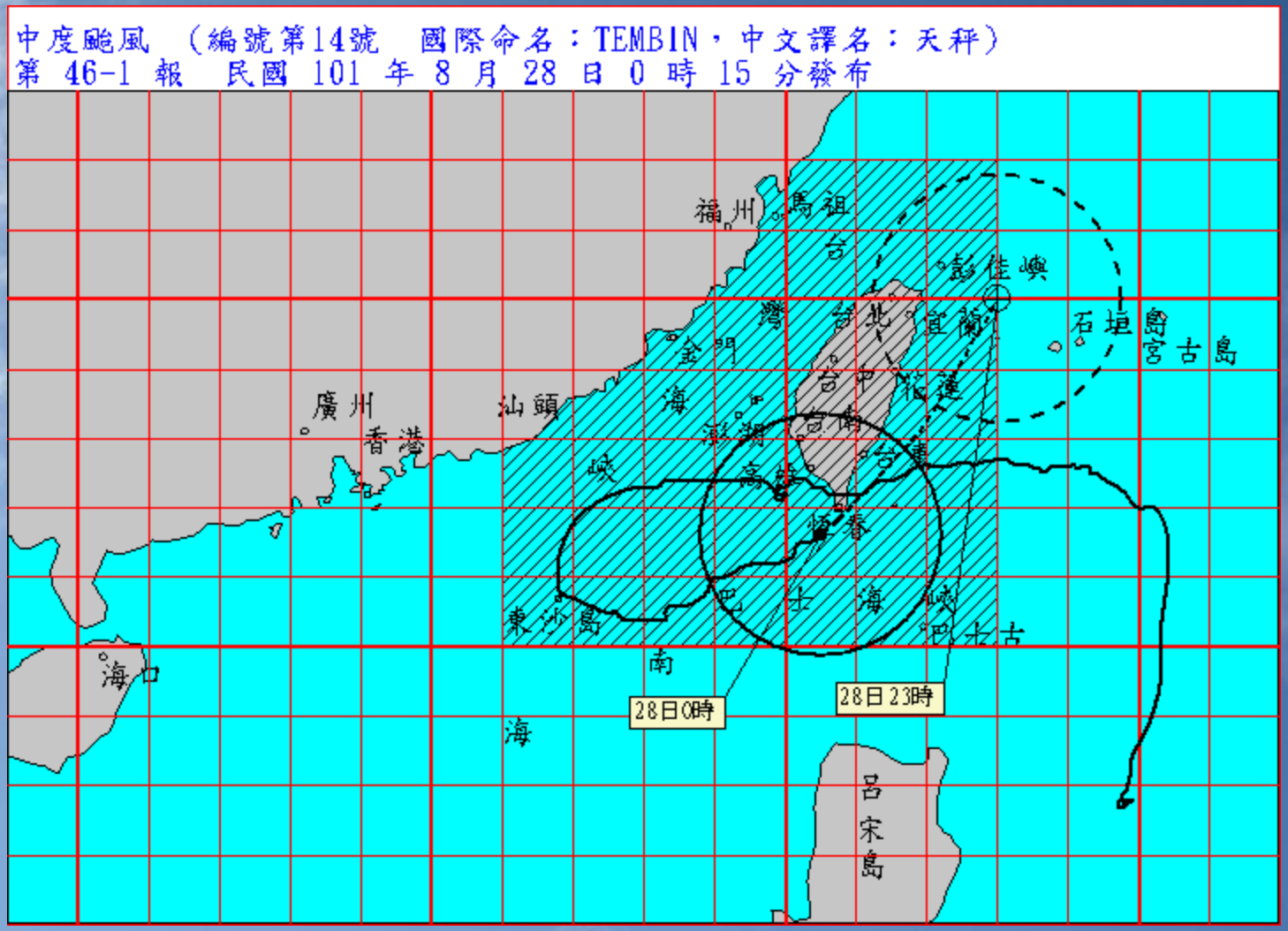
- **Taiwan is the most often threaten area**



2009 Morakot
- Max rainfall 3060mm
- 15 gauges > 2000mm
- in 48 hours

TEMBIN (15-29/8/2012)

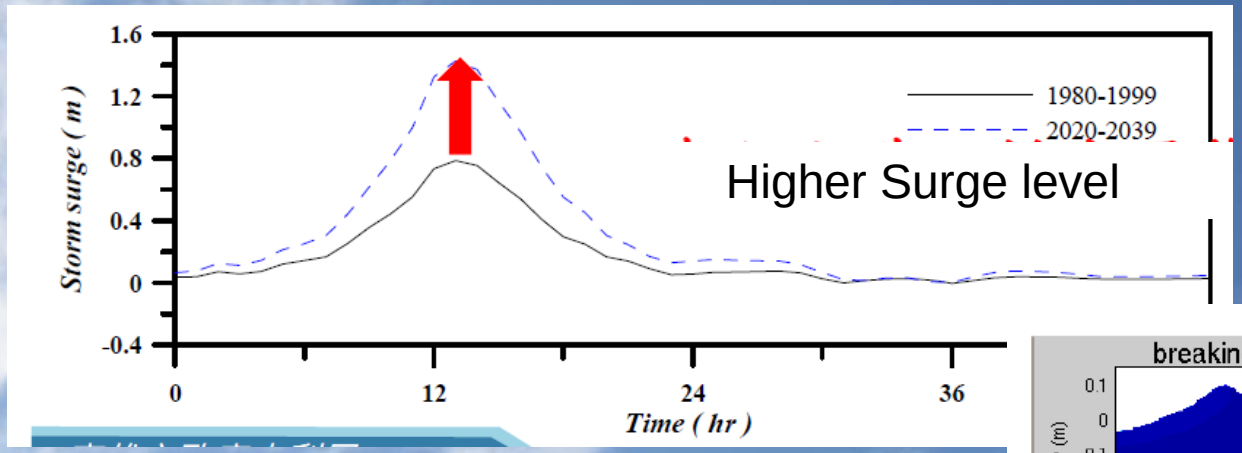
The most weird typhoon ever!

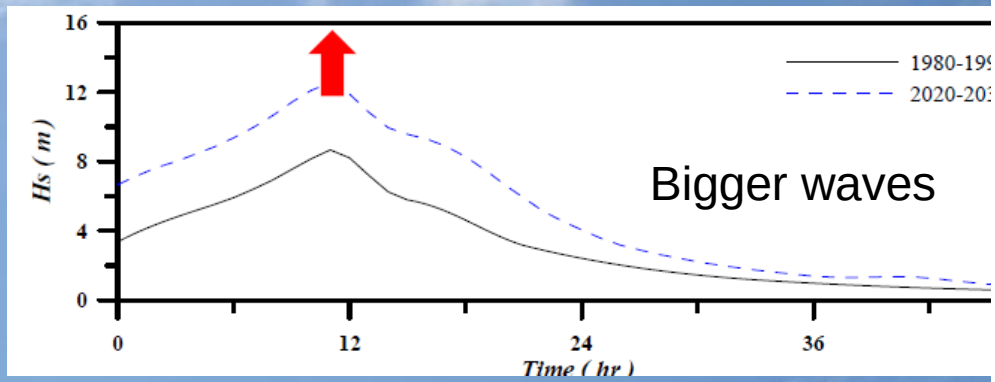


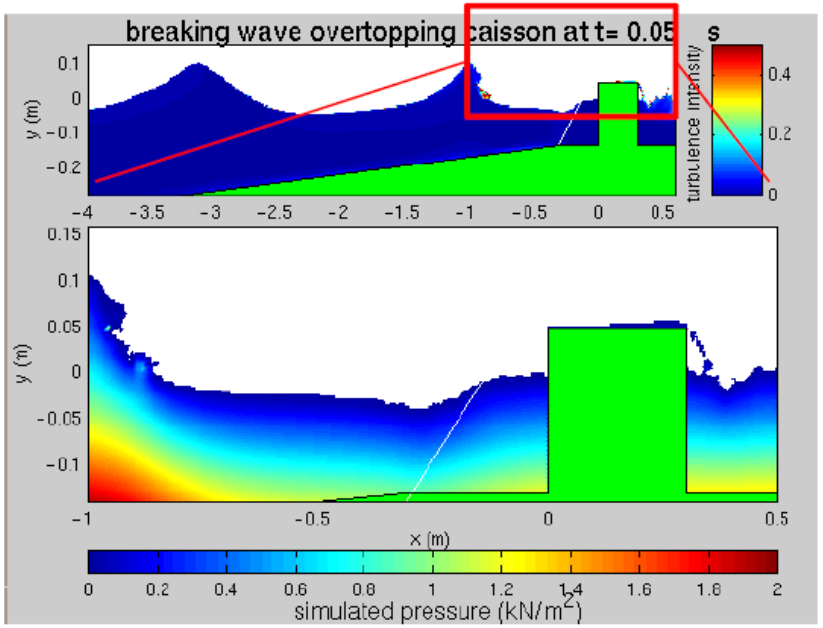
Challenges on Coastal Defense

Typhoon induced Surge and Wave conditions estimated for 2020-2039

(WRA, 2010)





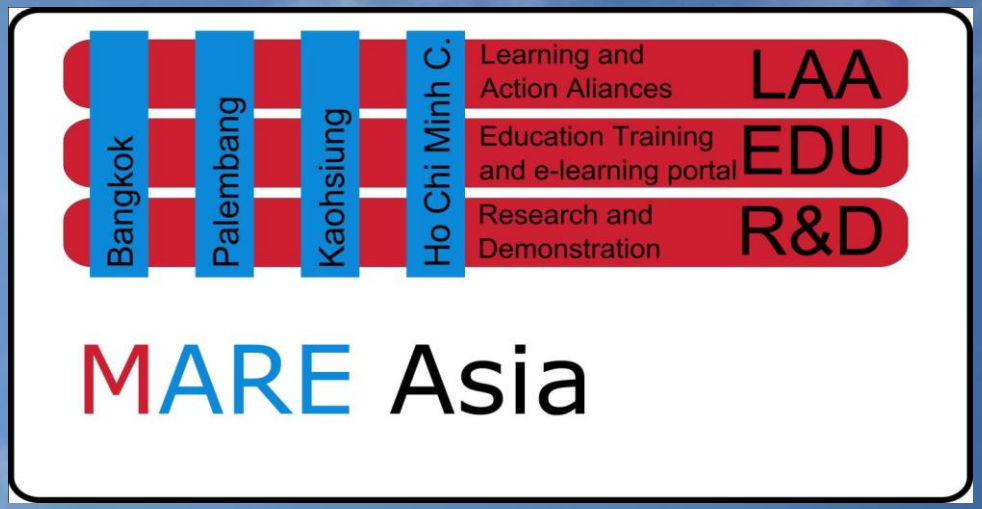


science - policy co-ops

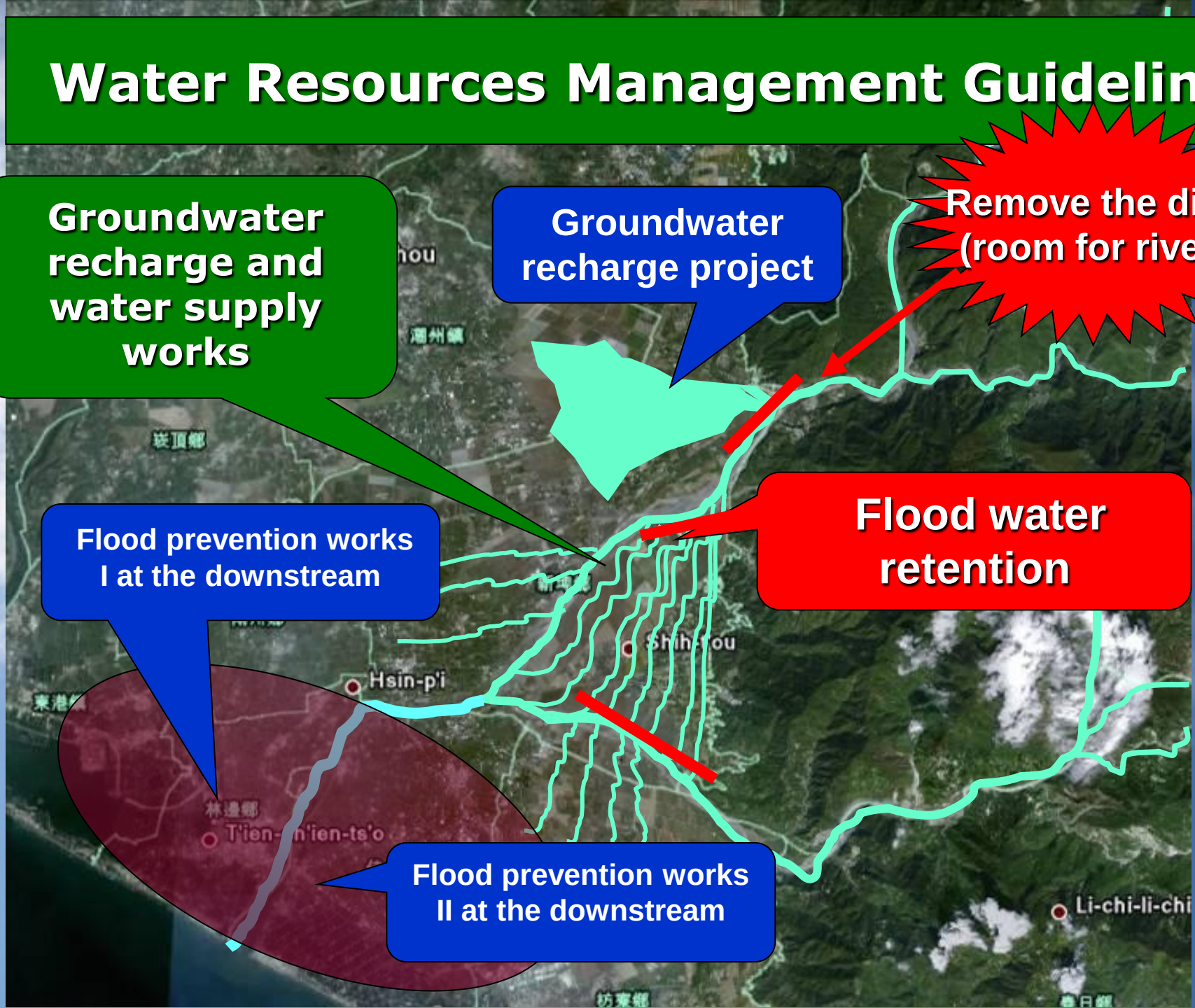
Climate change is not “a” problem waiting for “a” solution

An integrated strategy to ensure sustainability in the context of climate change requires more than just good science and good communication … it requires …

- Trusted science
- Informed policy
- Motivated business
- Engaged public



Water Resources Management Guideline



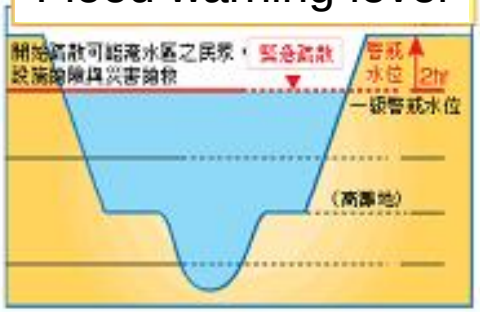
Kaohsiung City - Adaptation Measures

Catchment Management

Flood risk map

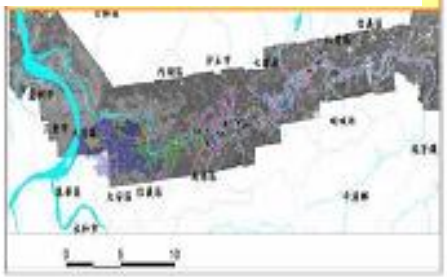
landslide risk map

Flood warning level



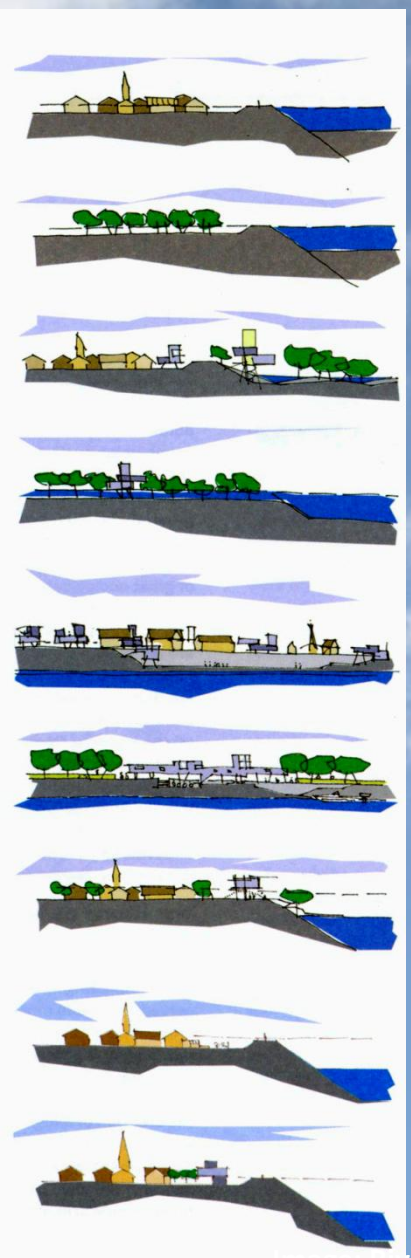
Contigency plan

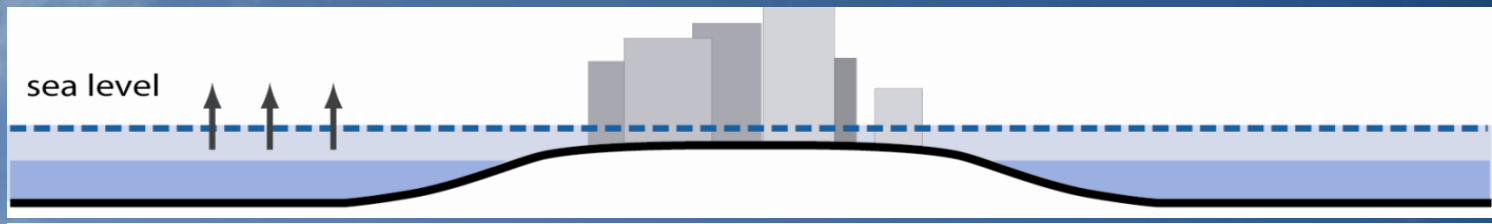
inundation map

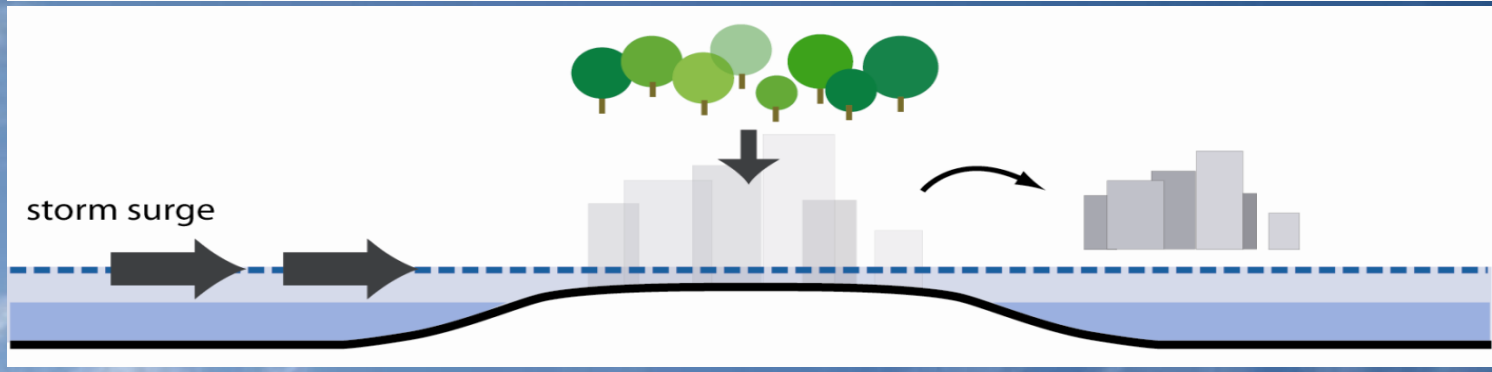


Flood resistant design

City in the Delta Area







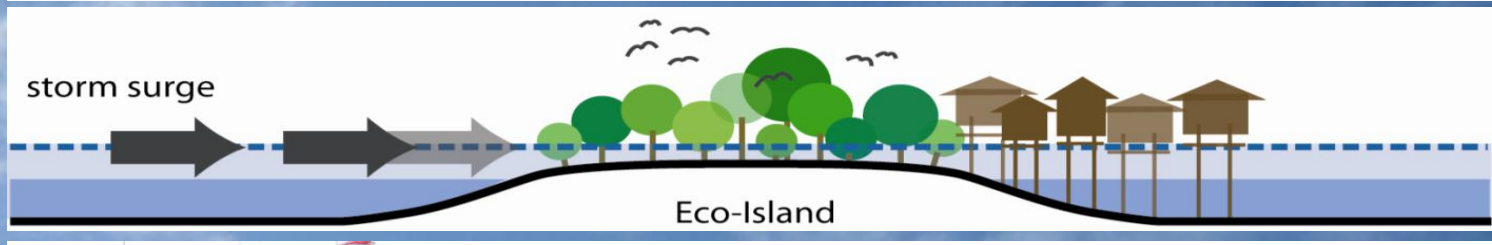


Image Ref: 李政儒
Li Cheng-ju

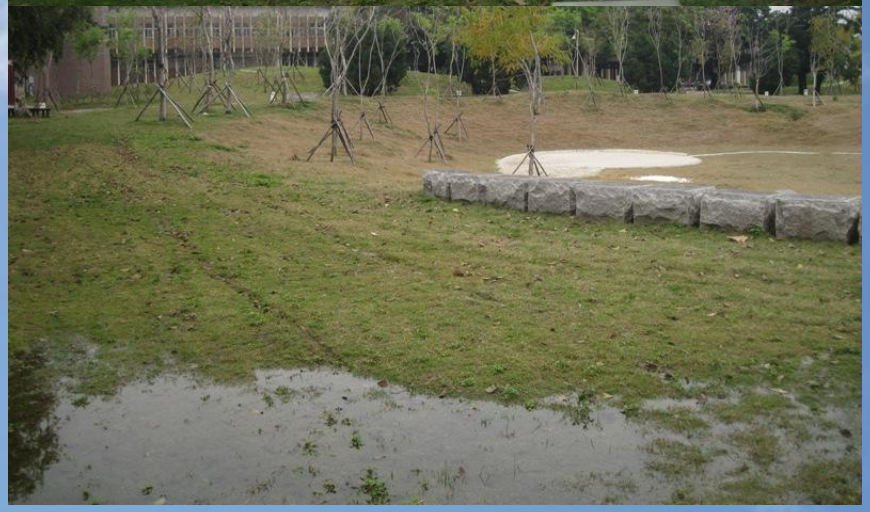
Image: Riverscapes

City Adaptations to Flood & Drought

Planning of sustainable rivers

Water Sensitive Urban Design Concepts
and comprehensive planning of city rivers

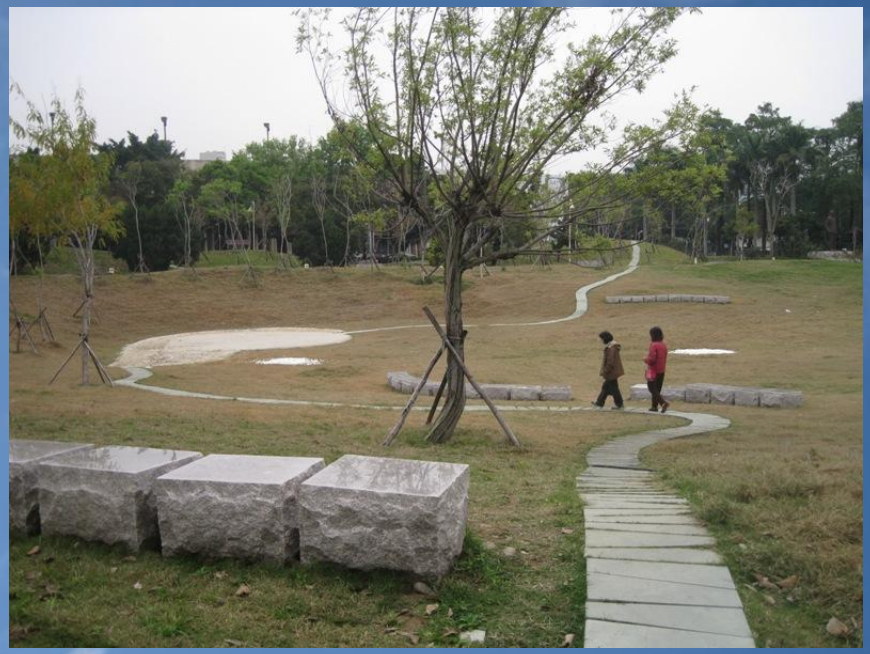
Adaptation Measures



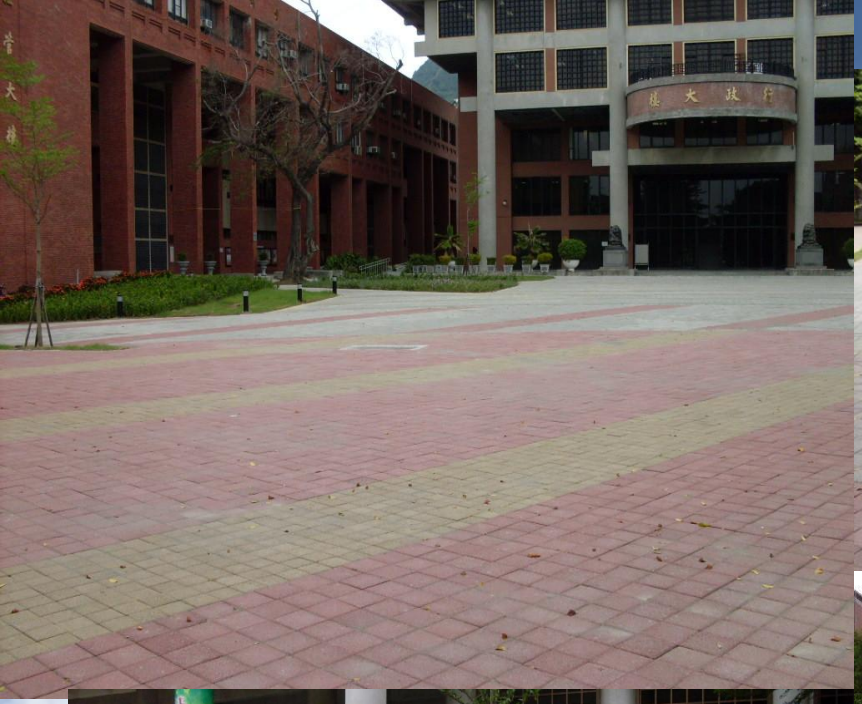
Reduce Park levels

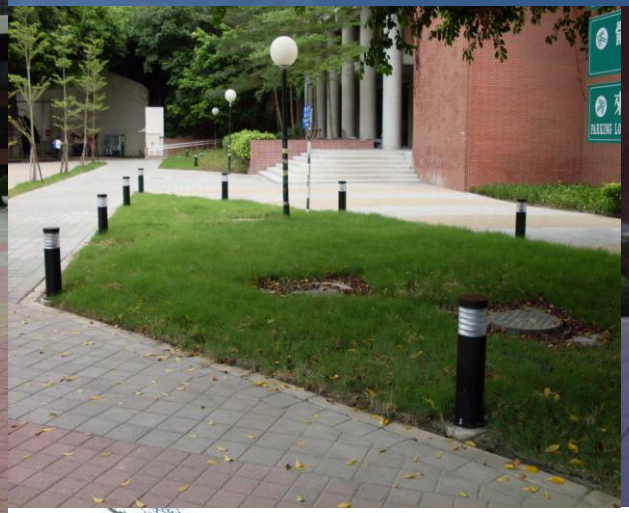
- Maintain original fuction

- As temporary detention ponds



Converting Hard Surface into Permeable

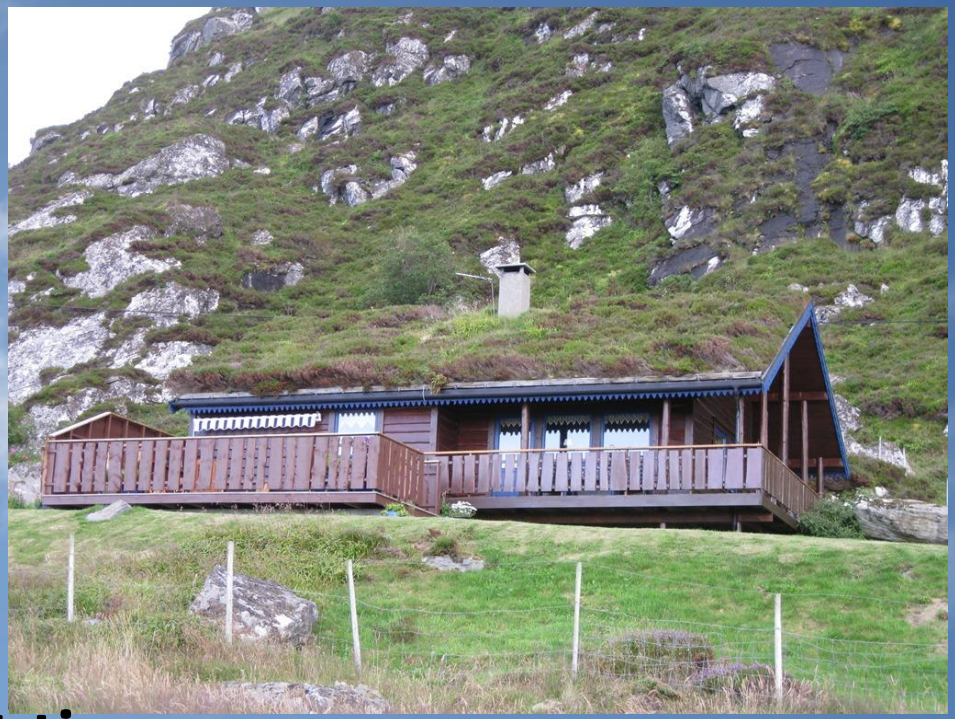




Advantages of Green Roofs

Temp isolations

- **Summer**
- **Winter**



Rain water can be cleaned!!

Reduce inlet time

- Less Floods!!!

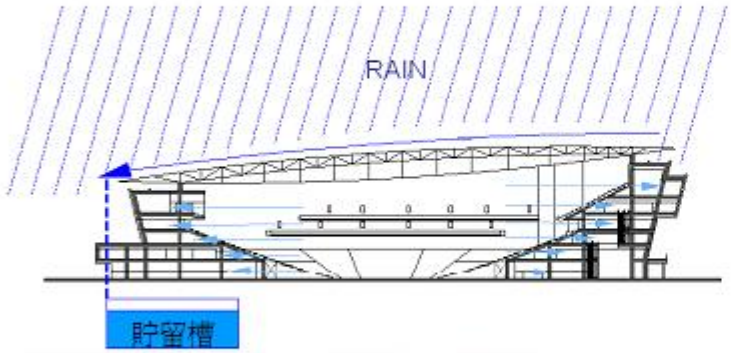
Absorb CO2

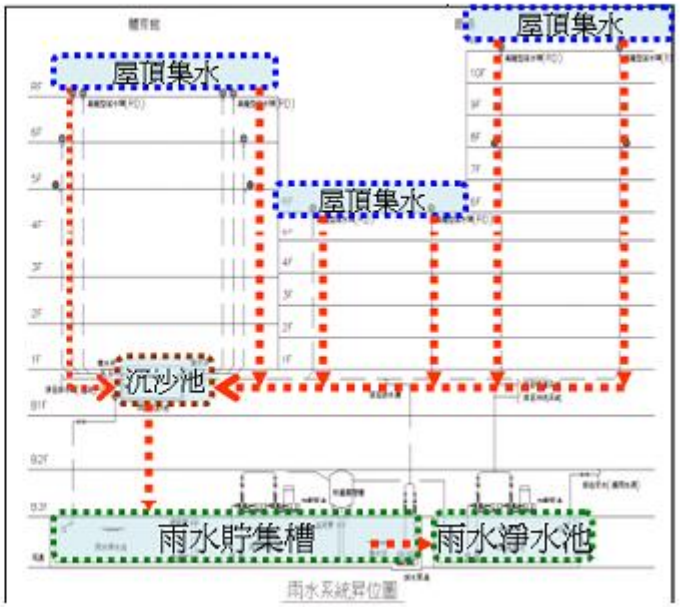
- Less air Pollution!!

Converting Public Roofs into Green

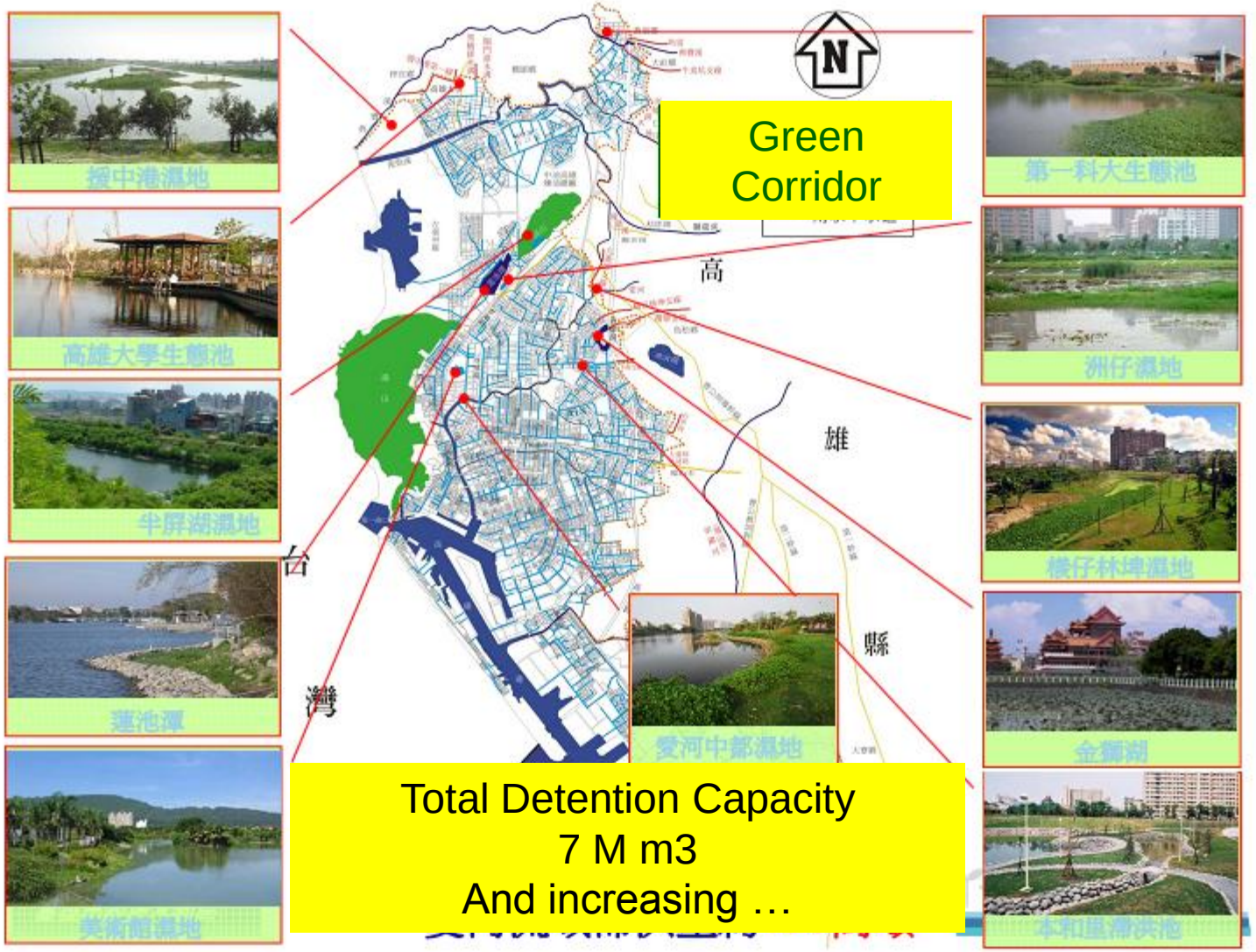
Adaptation Measures

Rainwater harvesting





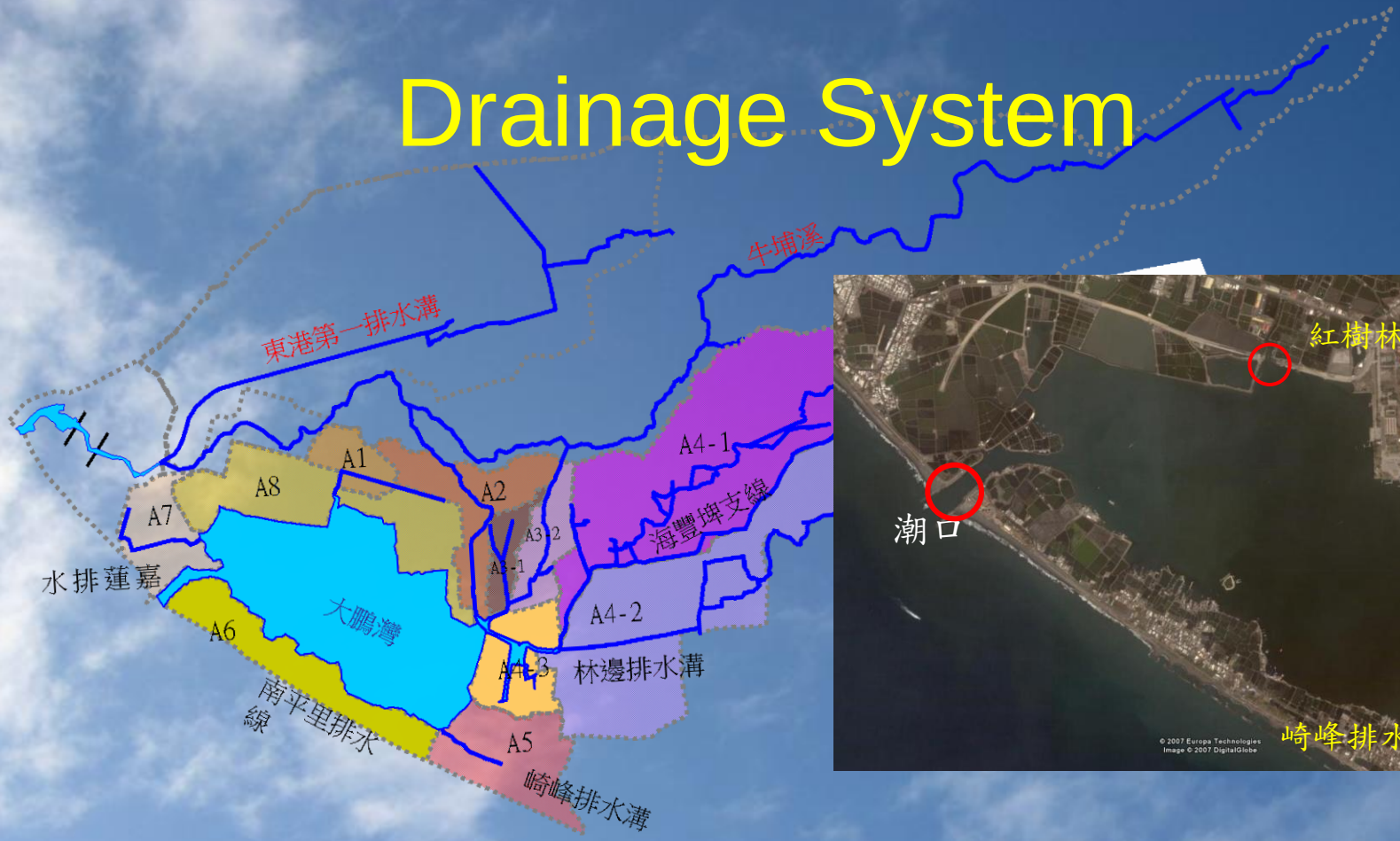
Green Corridor in Kaohsiung
– A link of Constructed Wetland and Flood Detention




The Dapeng Bay
Constructed Wetland Clusters

Pollution from neighbouring cities and aquaculture

Drainage System



Internal pollution from oyster farms and cagenets

External source

Causing Eutrophication,

Even Red Tides!

The Development Plan

5 Constructed Wetlands created for nutrient reduction, 2 created wetlands for nature and habitats, total 56 ha


嘉蓮濕地公園
紅樹林濕地公園
大鵬濕地
鵬村濕地
右岸濕地
左岸濕地
崎峰濕地
南平社區
人工溼地
環灣道路
水系
大鵬灣風景特定區範圍

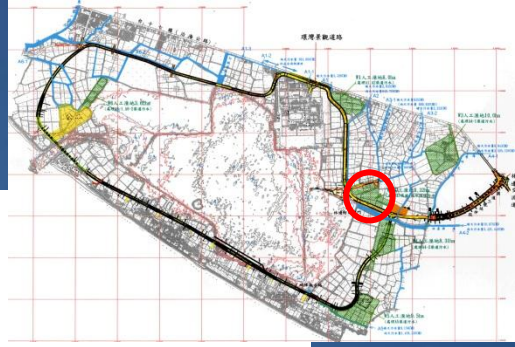
Datang Wetland Park

1.DWF 4200CMD
2.130,000M3 Detention Capacity
3.Created natural habitats and recreation area as water park

Pentsun Wetland Park

10ha

Right Bank Wetland Park



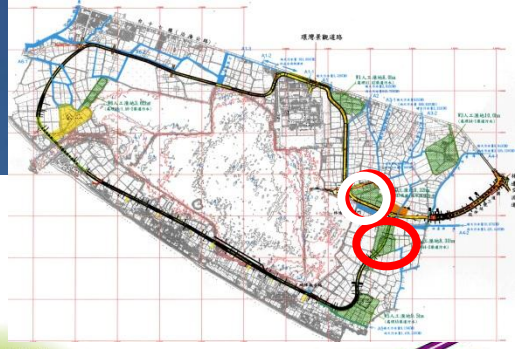
13ha

Right Bank Wetland Park

Right Bank Wetland Park

B區

Left Bank Wetland Park



Chifong Wetland Park

往 南平海堤
To Nanping Levee

抽水站
Pumping station

環灣道路
Circum-Bay Path

深水池
Deep Water Pond

淺水池
Shallow Water Pond

石籠過濾池
Gabion Filtration Pond

礫石過濾池
Pebble filtration pond

淺沼澤
Shallow swamp

生態池
Ecological pond

調節池
Water regulation pond

成功路
Chenggong Road

崎峰社區活動中心
Qifeng Community Activity Center

N
S

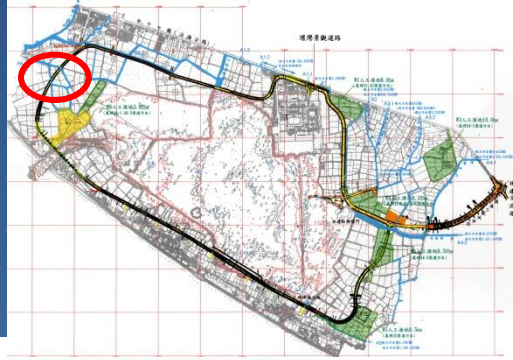
大鵬灣自行
Dapeng Bay Bik

環灣道路
Circum-Bay Path

眺望亭
Scenic outlook pavilion

Magrove Park

Chia-lian Wetland Park



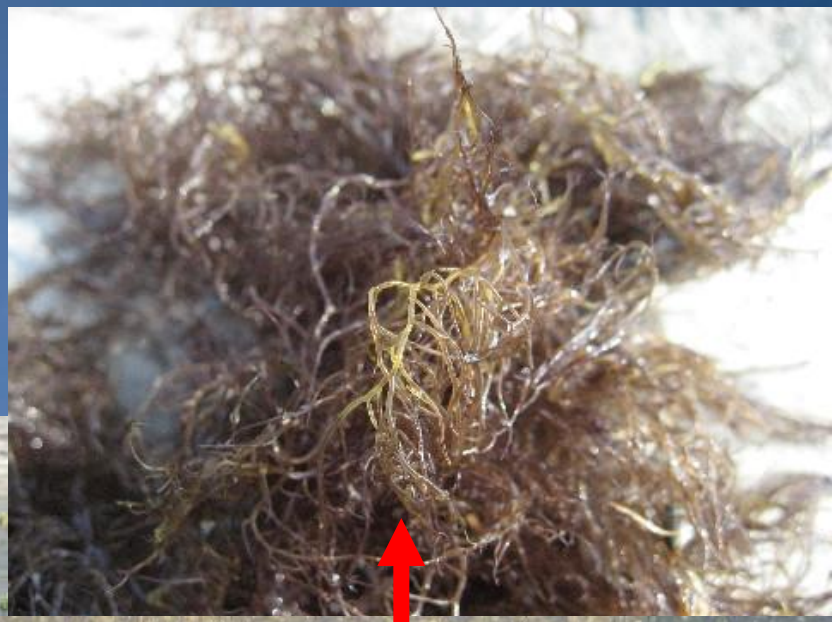
The only survived Mangroves in Taiwan

They Grow

Macro Algae

細基龍鬚菜

Gracilaria tenuistipitata



Help to clean

Revitalize a suburb city by supplying constant CLEAN water

千禧公園及
文化中心

中山公園
及屏東公署
周邊

文教學區與演藝廳

高屏溪舊鐵橋
河濱綠地

萬年公園景觀

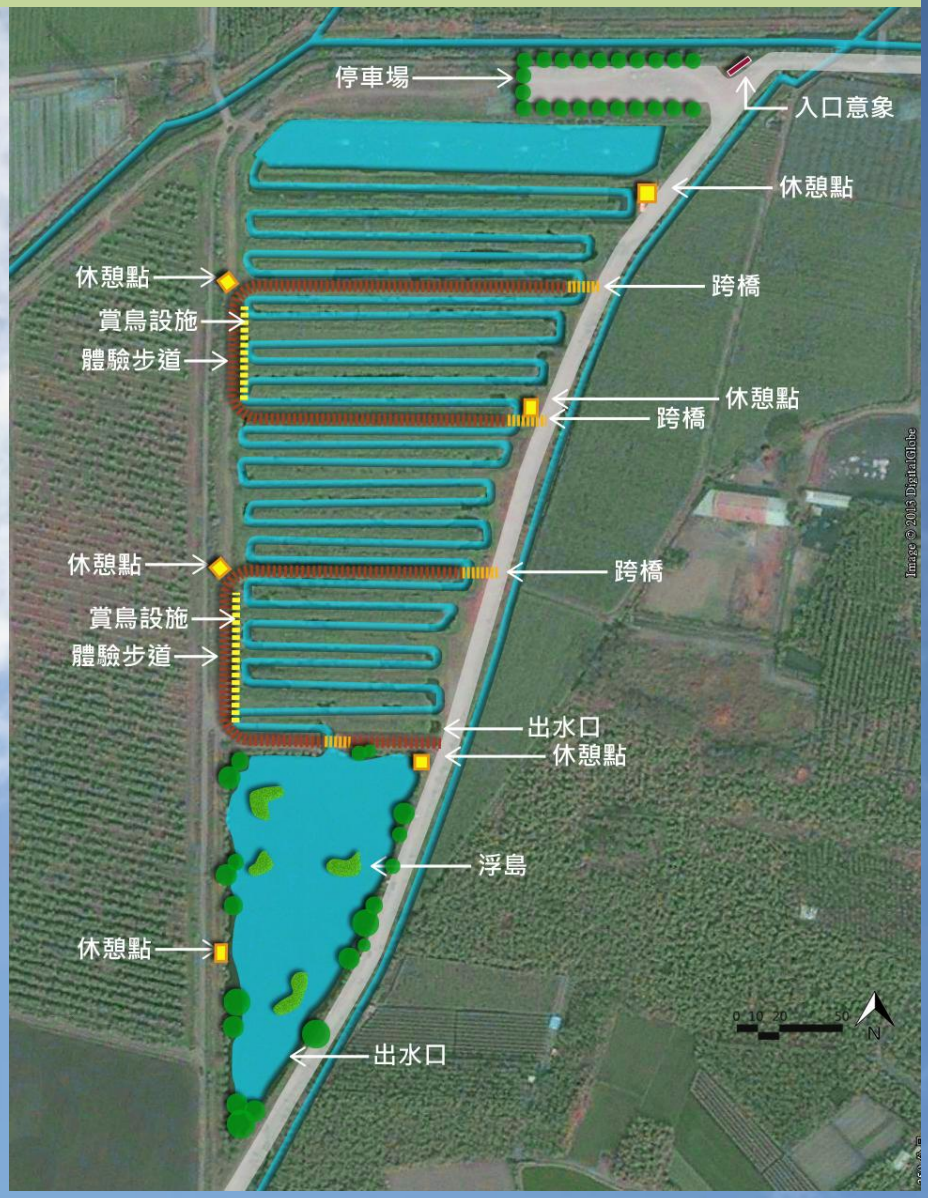
勞工公園
萬年公園
景觀橋

大武營

台糖農場

Using CW to treat polluted water for supplying CLEAN water to the river

海豐濕地 Haifong Wetland



圳寮濕地 Tsunliao Wetland

AFTER

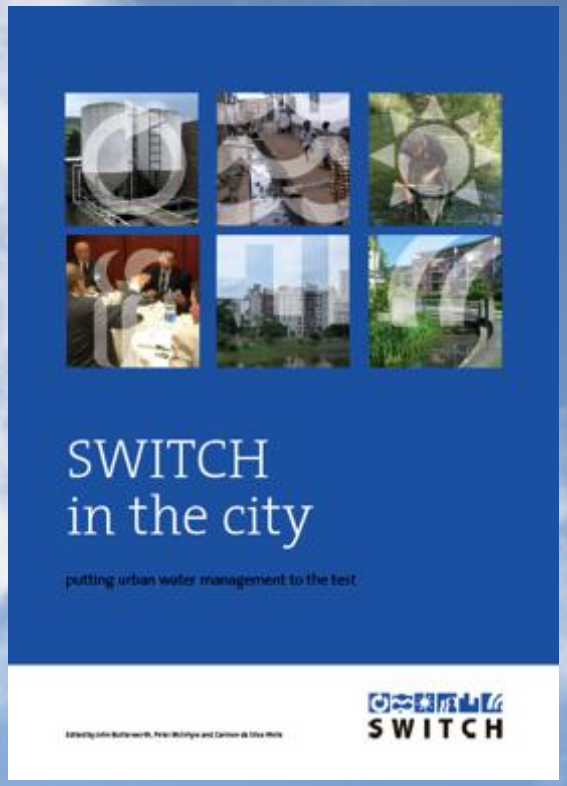
Sustainable River City

Besides LESS flooding,

We are getting …

- Better environments
- Improved living standards
- Increasing house values

EU Connections



MARE Asia

Joint programme MARE Asia-EU

•Maximize the added value of water in urban areas

•Water sensitive urban design (WSUD)

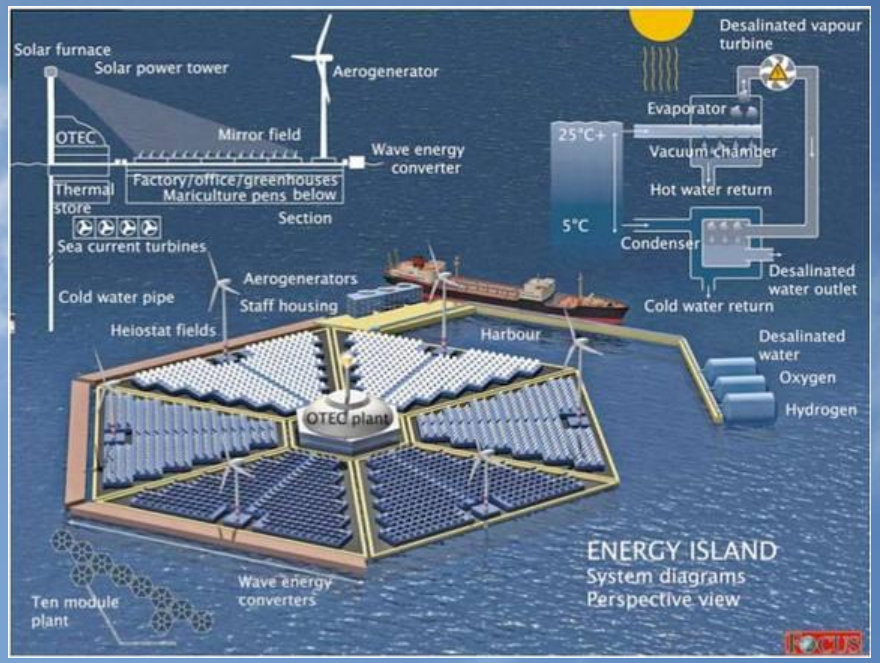
• Participating cities: Palembang (Indonesia), Kaohsiung (Taiwan), Rijnmond (Rotterdam-Dordrecht, NL), Bangkok (Thailand) and HCMC (Vietnam)

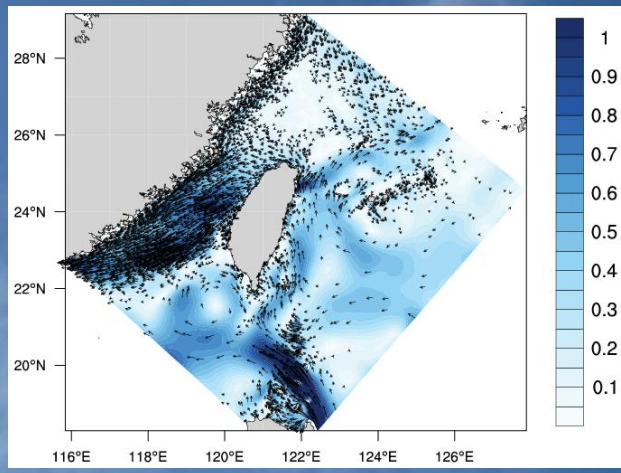
EU Project

TROPOS : Multi-use offshore platforms

" Modular Multi-use Deep Water Offshore Platform Harnessing and Servicing Mediterranean, Subtropical and Tropical Marine and Maritime Resources “

- Grant agreement no: 288192, 2012-02 ~ 2015-01
- 18 Partners (including NSYSU, support by NSC,Taiwan)





Tropos

SEVENTH FRAMEWORK PROGRAMME

Kaohsiung City – Learning & Action Alliance

Annual Water Management Forum

October 12-13, 2010

April 20, 2011

April 25-26, 2012

April 23-24, 2013

Kaohsiung, the Ocean Capital of Taiwan

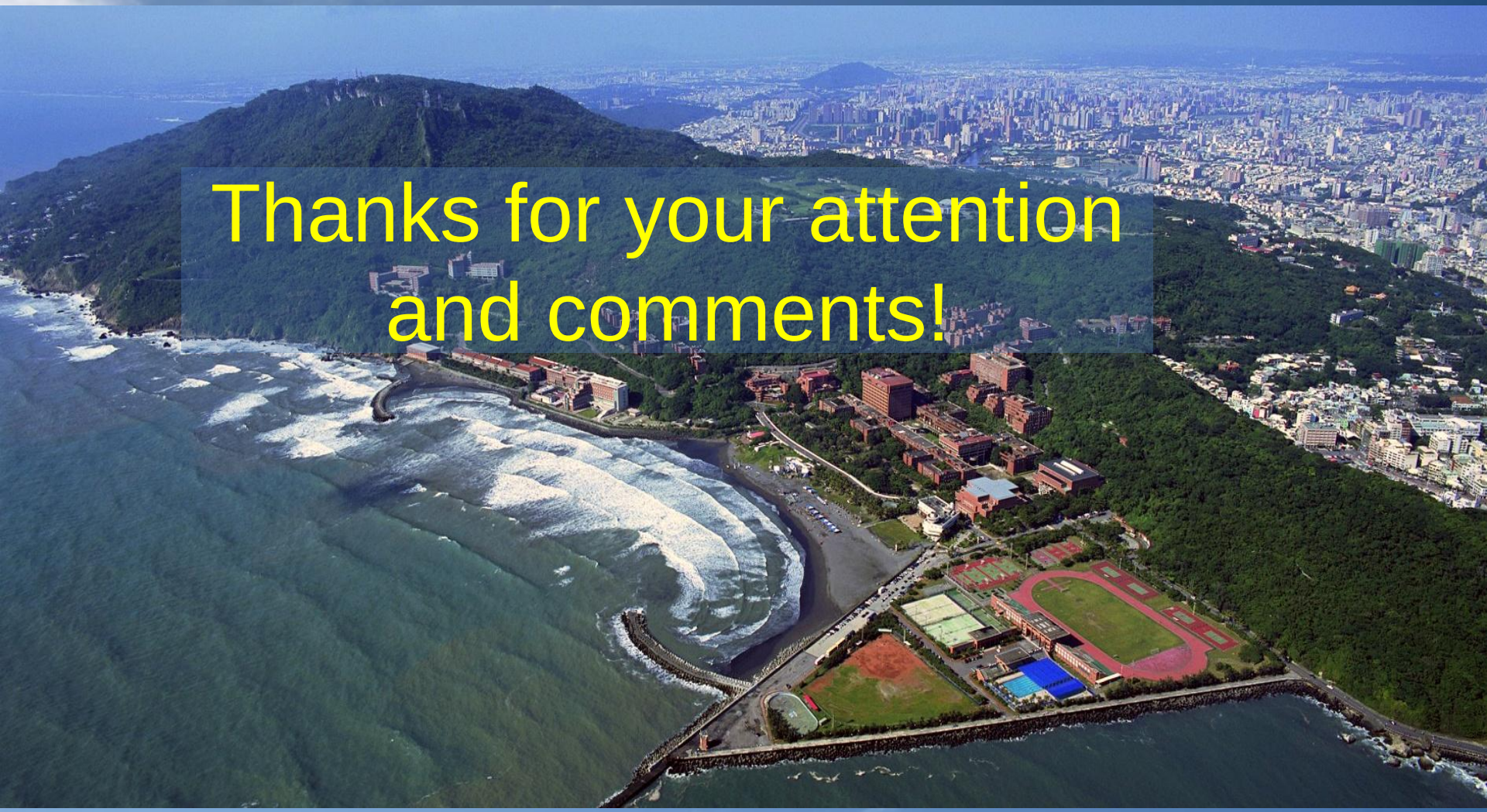


Image: 高雄市政府 Kaohsiung City Government