Rebuilding from Hurricane Sandy: A Local-Federal Partnership for Equitable and Resilient Disaster Recovery

Anhthu Hoang
US EPA Region 2
Environmental Justice Program

Federal Coordination Framework

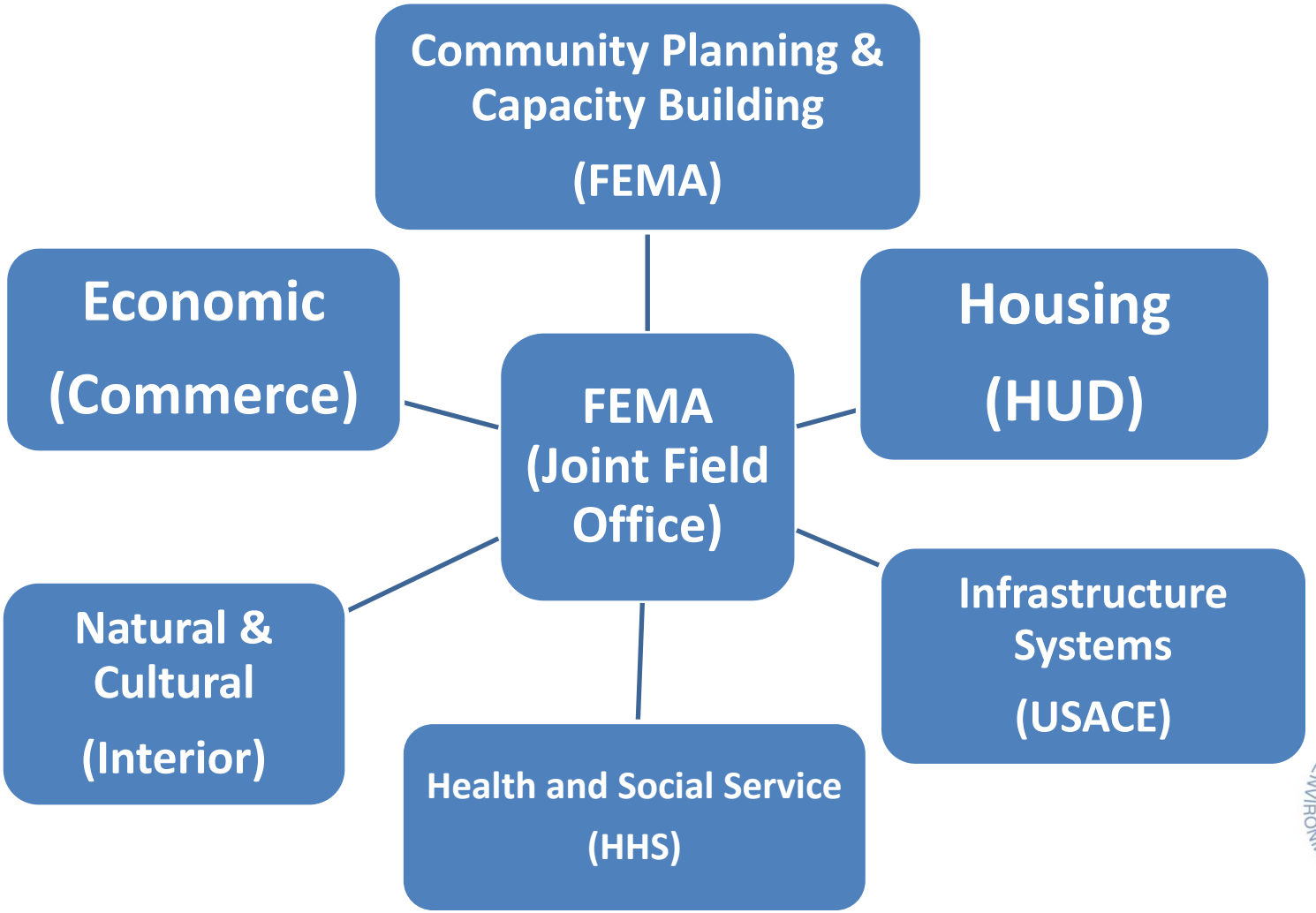
The National Disaster Recovery Framework

- **Structure**
  - Flexible
  - Respect needs of each event
- **Function**
  - Support impacted States, Tribes, Territories and localities
  - Enable coordination & collaboration
- **Objective**
  - Restore, redevelop and revitalize the health, social, economic, natural and environmental fabric of the community
  - Build resilience

NDRF Elements

- Defines Core Recovery Principles
- Roles and responsibilities (FEMA & Stakeholders)
- Structure for Communication and Collaboration
- Guidance for pre- and post-disaster planning
- Process for supporting communities to rebuild

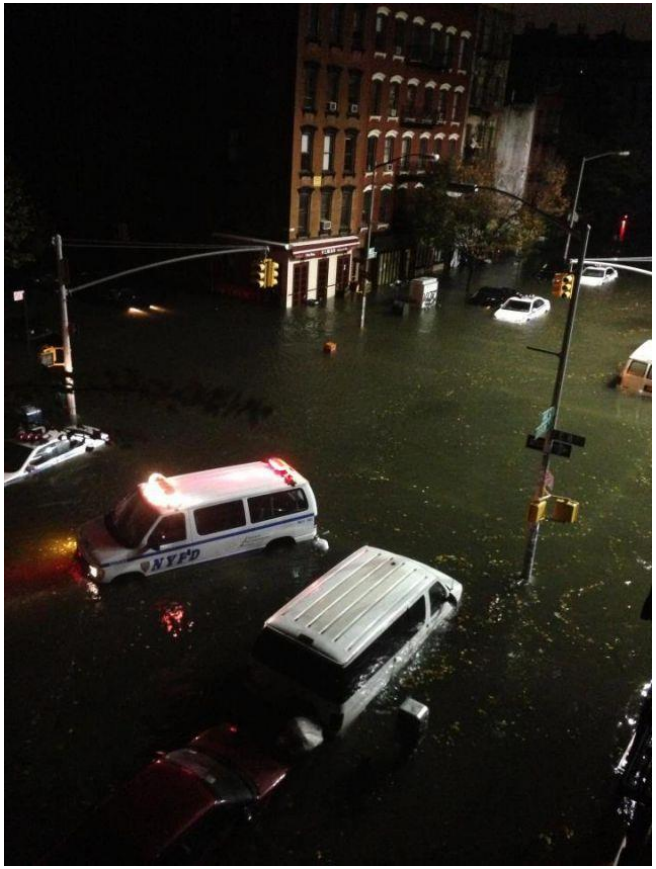
NDRF Coordination Through Recovery Support Functions



Long Island Context

- Economics
  - Reliant on New York City
  - Limited housing affordability
  - Transportation access limits economic growth
- Environment
  - Coastal flood threat
  - Severely degraded coastal habitats
  - Sole source aquifer
- Population
  - Shifting age structure
  - Environmental Justice Communities

Hurricane Sandy Impact: Long Island, NY



- Coastal communities devastated

Hurricane Sandy Impact: Long Island, NY

100,000 homes severely damaged, destroyed or severely flooded

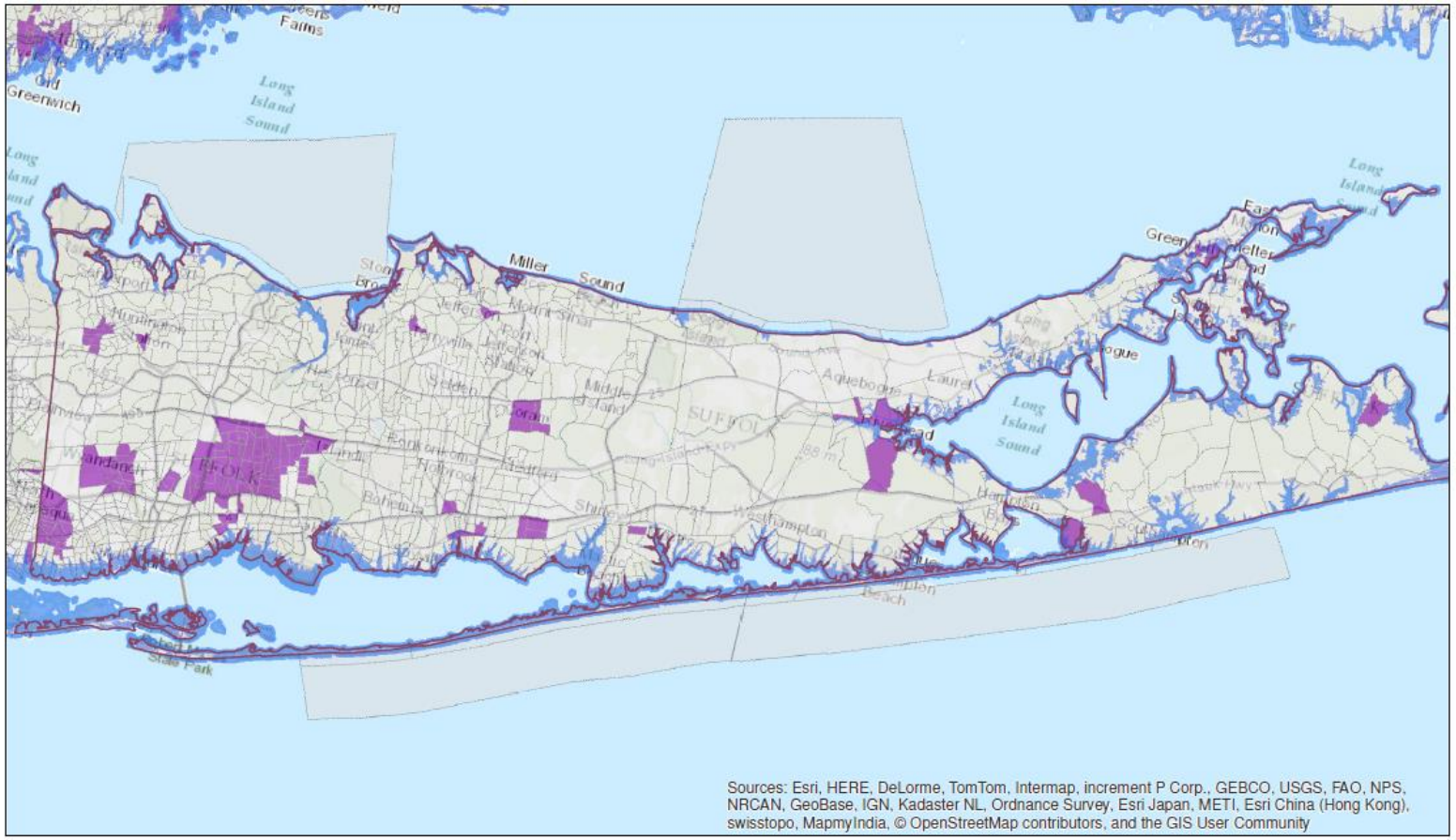
Hurricane Sandy Impact: Long Island, NY

- **900,000 households lost power; many for up to 4 weeks**
- **Downed trees and power lines caused many fires**

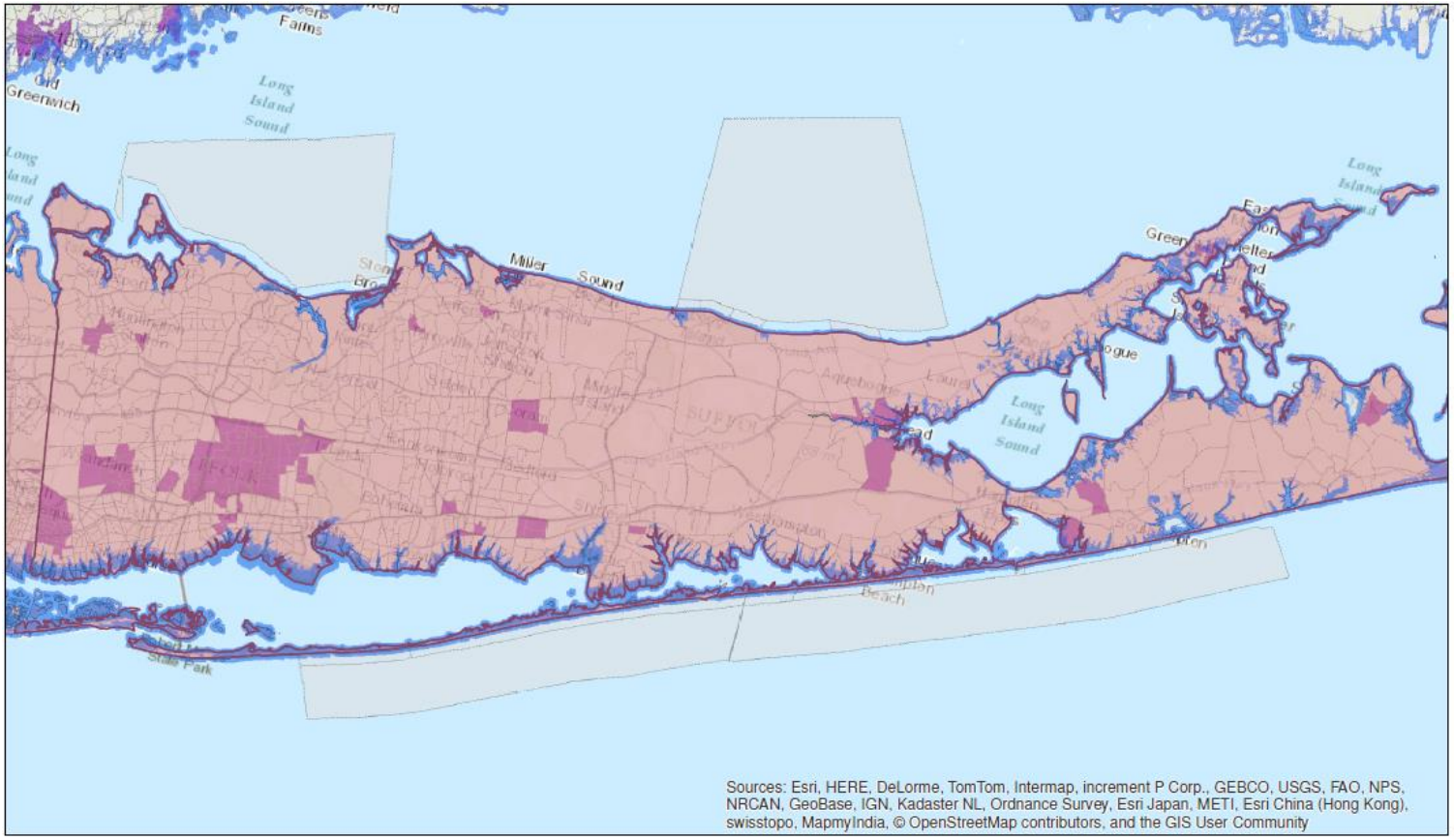
Hurricane Sandy Impact: Long Island, NY

- **Debris presented major logistical and justice challenges**

Long Island Vulnerable Communities: Low-income communities of Color



Long Island: Sandy Surge Line & Sole Source Aquifer



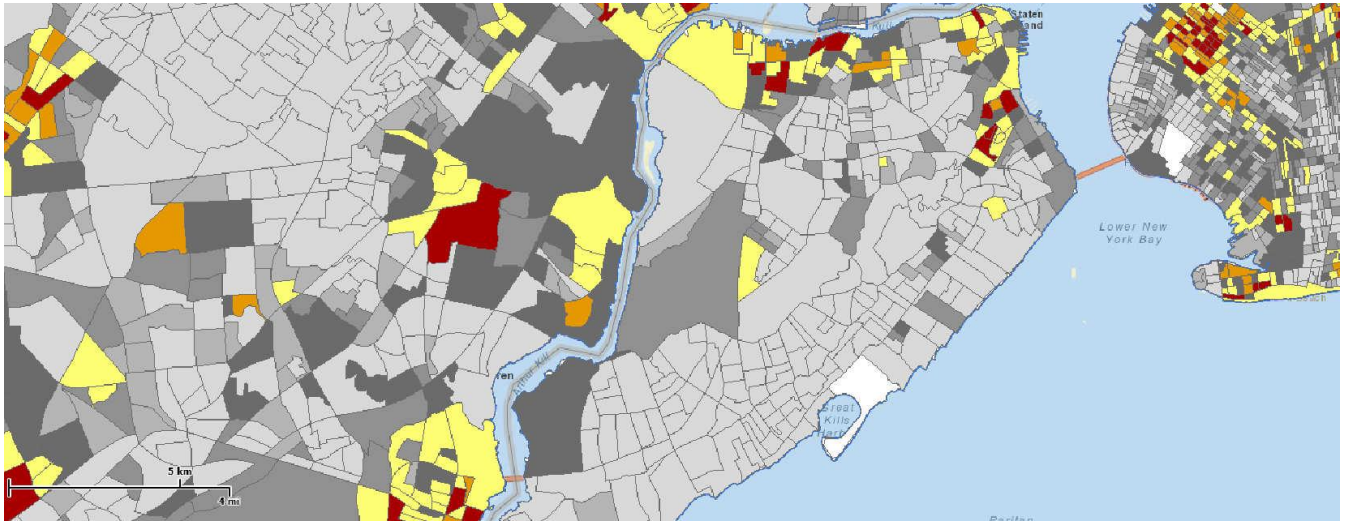
NDRF Implementation

- Community Planning and Capacity Building RSF
  - Sandy Sustainable and Equitable Development Working Group
  - Federal, state, and county government partnership
- Recovery Support – A Tailored Approach
  - Needs Assessments
  - Connect Resources with Needs

Federal Support for Hurricane Sandy Recovery

- Sharing Data and Analytical Tools
- Capacity Building – Training
  - Health Impact Assessment
  - Scenario Planning
  - Community Engagement
- Policy Support
  - HIA and Monitoring
  - Ecosystem Goods and Services Assessment
  - Cost Benefits Analysis
  - Technical Planning Support

EPA's EJSCREEN: Identifying Vulnerable Communities



- PM 2.5 Level in Air
- Ozone Level in Air
- Diesel Particulate Matter Level in Air
- Air Toxics Cancer Risk
- Air Toxics Neurological Hazard Index
- Air Toxics Respiratory Hazard Index
- Traffic Proximity and Volume
- Lead Paint Indicator (% pre-1960)
- Risk Management Plan Facility (Proximity)
- Superfund Site (Proximity)
- Treatment Storage Disposal Facility (Proximity)
- Major Direct Water Dischargers (Proximity)

Rebuilding Toward More Resilient Coastal Communities

Lifestyle-supportive amenities & transportation

Water-centered community & recreational space

Thank You!

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Cross-sectoral Risk Assessment and Resilience Building

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Bioenvironmental Systems Engineering
National Taiwan University

Contents

- Background
- TaiCCAT
- Cross-sectoral Sytem Dynamics Model
- Vulnerability and Resilience Indicators
- Final Remarks

More Frequent and Intensive Extreme Events

2001 Typhoon Nari（納莉）

425 mm/day

2004 Typhoon Aere（艾利）

800 mm/day

2009 Typhoon Morakot（莫拉克）

1000s mm/day

Wall of Flooding Record - ChiaDong

More Intensive Rainfall
2014.05.15 台中一時雨量 90mm/hour

台中暴雨淹地下道 2子獲救母亡

【聯合報／記者余采瀅／即時報導】

2014.05.16 12:56 pm

More Intensive Rainfall
2014.06.03 嘉義一時雨量 116mm/hour

暴雨襲嘉！時雨量116mm　創46年紀錄

時間：2014/06/03 12:27

標籤： 大雨

熱門度 :854

搜尋...

字型大小： 小 中 大 特大

4.3 萬 讚　0 分享　59 推薦

本日最新新聞

- 東區有蛇！1.5米臭青母逛大街　嚇壞人 (07:46)
- 美奧勒岡發生校園槍擊案　2人身亡 (07:42)
- 化身療癒女神　「安心亞」實現童話夢 (07:33)
- 大甲媽湄洲謁祖　吸400宮廟上萬人進香 (01:24)
- 加盟展450攤位　規模歷年最大 (00:35)
- 「捏爆哥」踢館　冰淇淋老闆退錢不賣 (00:33)

more

本日熱門新聞　本周熱門新聞

- 「3個月包瘦」　直銷產品無效爆糾紛
- 首提訊！　葉世文鬆口「拿錢沒辦事」
- 「捏爆哥」踢館　冰淇淋老闆退錢不賣
- 便宜近5成！全車烤漆9千　低價搶客
- 為取悅虛擬「妖瘦男」　13歲女孩刺母
- 麵包銷售速度「蔥」最快　30分800個搶光
- T型人搶手　具通才+專才特質
- 東區有蛇！1.5米臭青母逛大街　嚇壞人
- 免收銀機！「點餐APP」　徐重仁兒子獲獎
- 大甲媽湄洲謁祖　吸400宮廟上萬人進香

TVBS

Typhoon Maggie 10/21/2010

- Max. Rainfall 183 mm/hour
- Design rainfall for drainage system of major city in Taiwan is around 70mm/hour (78.8mm/hour for Taipei Metropolitan Area)

Can traditional design standards of infrastructures meet the requirement to mitigate new disaster?

Rrecord-Breaking High Temperature

9/15/2014

Taoyuan 37.9°C, Highest temperature of this year

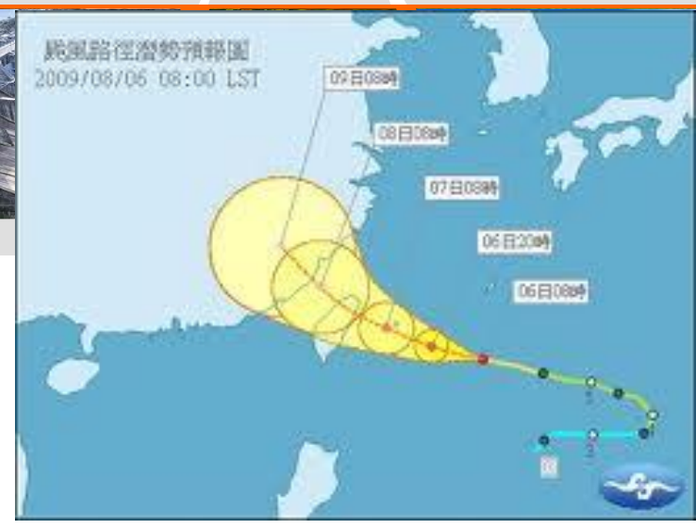
9/15/2014

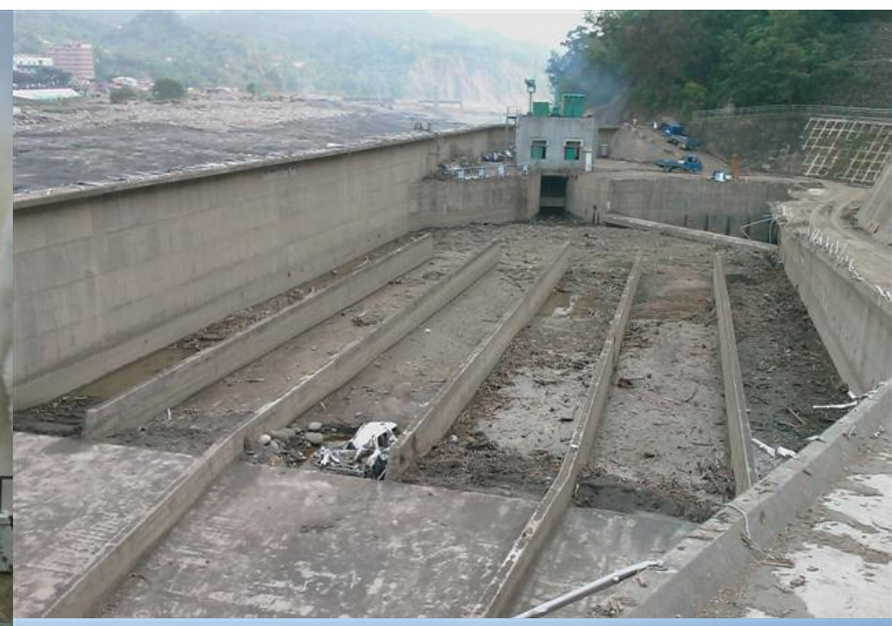
Kaohiong 37.6°C, Breaking the record of the past 82 years

9/16/2014

Taipei 37.8°C Breaking the record of the past 100 years

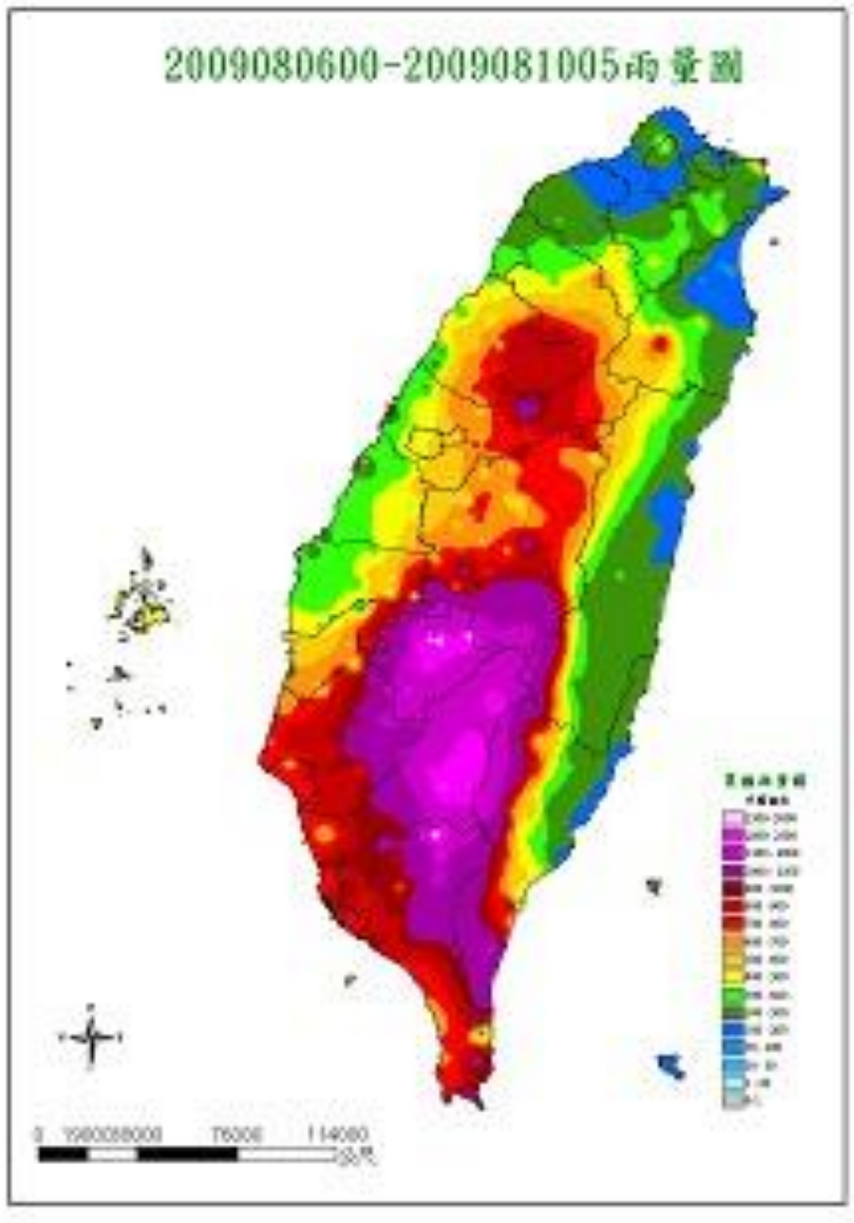
Typhoon Morakot 莫拉克颱風
August 7-8, 2009





96-hour cumulative rainfall (mm)

（資料來源：農委會水土保持局 http://88flood.swcb.gov.tw/form/index-1.asp?m=3&m1=35&m2=330&id=1090）



Rank	County	Area	Station	Precip.
1	屏東縣	三地門鄉	尾寮山	2888
2	嘉義縣	竹崎鄉	奮起湖	2796
3	高雄縣	桃源鄉	御油山	2792
4	高雄縣	桃源鄉	溪南	2719
5	高雄縣	桃源鄉	南天池	2688
6	嘉義縣	竹崎鄉	石磐龍	2622
7	高雄縣	桃源鄉	小關山	2473
8	嘉義縣	阿里山鄉	瀨頭	2354
9	高雄縣	六龜鄉	新發	2325
10	屏東縣	三地門鄉	上德文	2254
11	嘉義縣	番路鄉	大湖	2239
12	高雄縣	桃源鄉	高中	2224
13	嘉義縣	大埔鄉	馬頭山	2202
14	高雄縣	桃源鄉	復興	2198
15	高雄縣	桃源鄉	楠溪	2058

Top ten 24-hour rainfall recorded in Taiwan

單日10大降雨量排行

名次	站名	雨量（單位：毫米）	颱風名稱	
1.	屏東尾寮山	1397.0	莫拉克	
2.	高雄溪南	1287.0	莫拉克	2009/08/08
3.	高雄御油山	1267.0	莫拉克	
4.	花蓮布洛灣	1222.5	安　珀	1997/08/29
5.	高雄新發	1181.0	莫拉克	
6.	嘉義馬頭山	1174.0	莫拉克	
7.	屏東瑪家	1163.0	莫拉克	2009/08/08
8.	嘉義奮起湖	1153.5	莫拉克	
9.	高雄小關山	1151.5	莫拉克	
10.	嘉義石磐龍	1147.0	莫拉克	

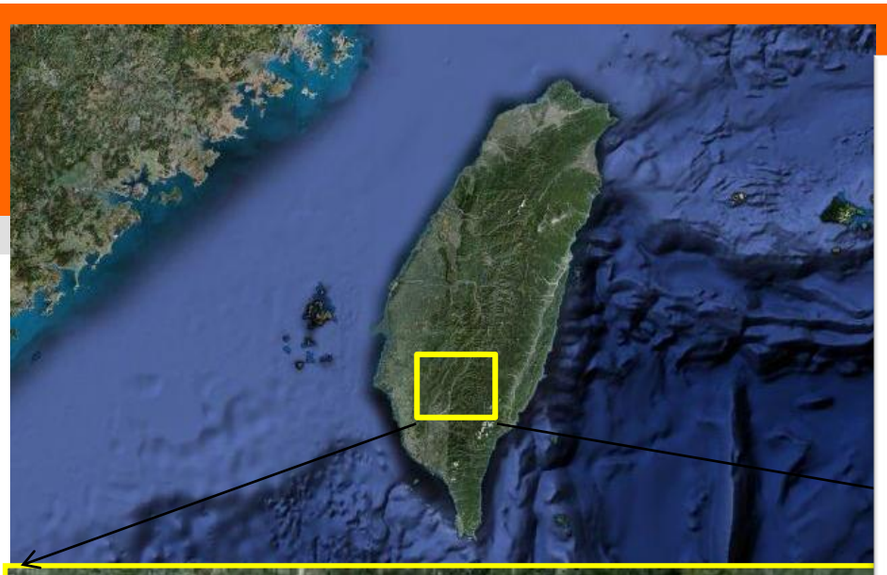
註：莫拉克颱風測站數據僅統計至2009年8月8日23:40

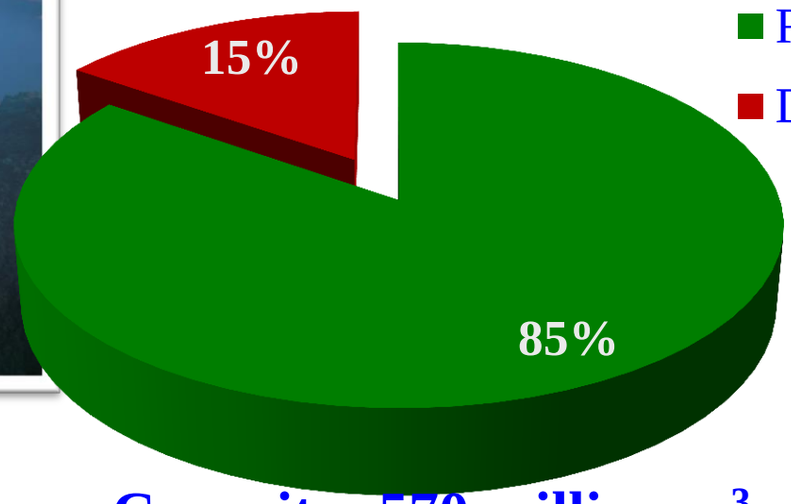
資料來源／中央氣象局　　製表／楊正敏　　聯合報

Shiao-Lin village 小林村

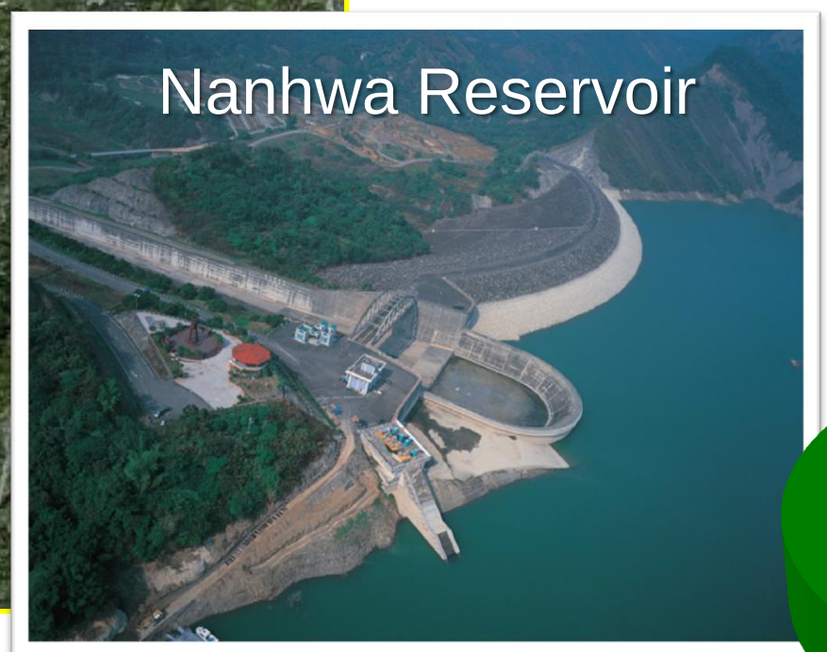
Shiao Lin village,Taiwan, drastic changes after typhoon Morakot.

資料來源：http://img200.imageshack.us/img200/961/shiaolinaftermorakot.jpg

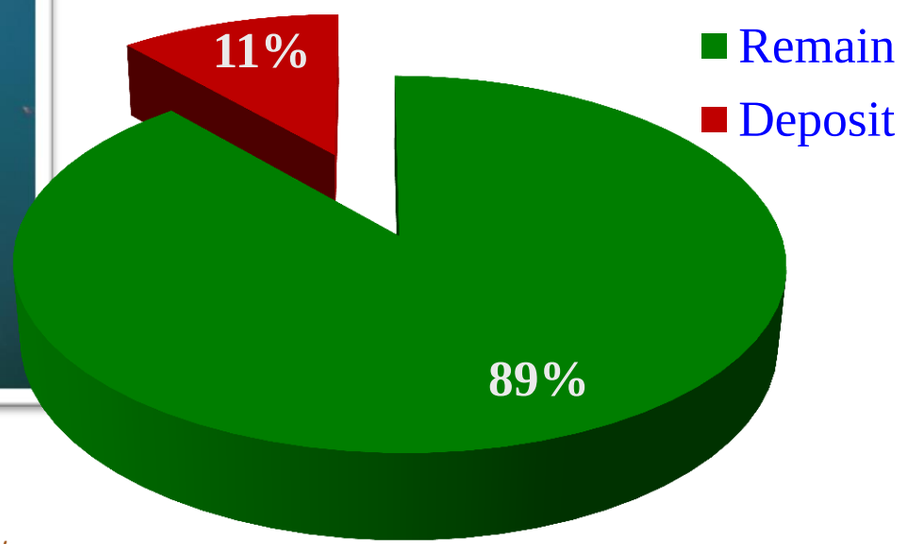




Capacity: 570 million m³
Deposit: 90 million m³



Capacity: 150 million m³
Deposit: 17 million m³



Taiwan integrated research program on Climate Change Adaptation Technology (TaiCCAT)

- Funded by Ministry of Science and Technology, Taiwan

Working Group II:
Cross-Sectoral Vulnerability Assessment and Resilience Capacity Building

Goal : Services for Different Stakeholders

General Public

Social Learning

Platform of Communication

Knowledge Platform

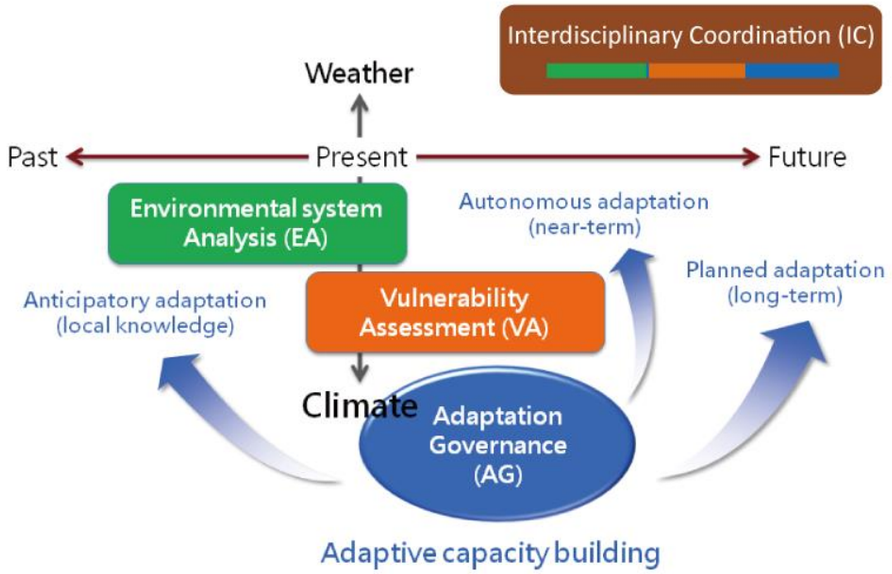
Academic Society

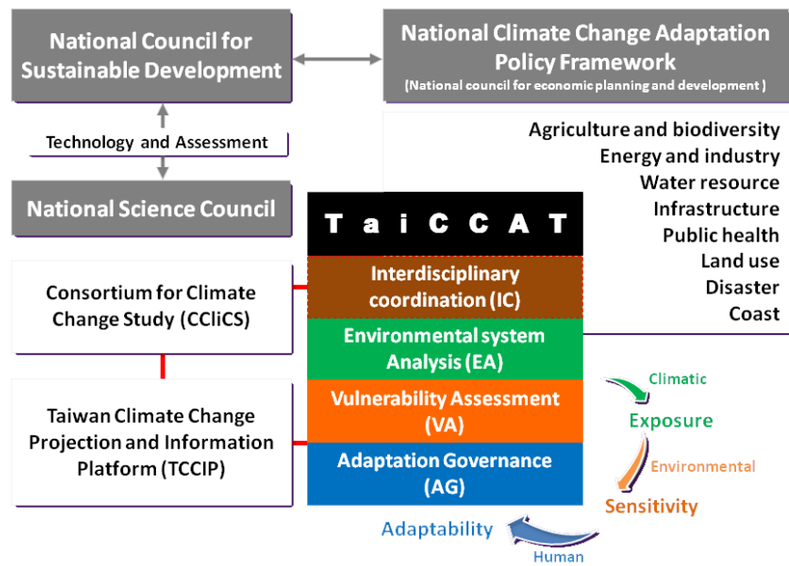
Governmental Agency

Research Planning

TaiCCAT - Framework

- PO : Project Office
  - Integration, Management, and Promotion
  - International Cooperation
- WG1: Environmental Analysis
  - Add-on analysis of monitoring data
  - Evidence-based adaptation measures
- **WG2: Vulnerability Assessment**
  - **Cross-sectoral vulnerability assessment**
  - **Assessment-based adaptation measures**
- WG3: Adaptation Governance
  - Risk governance
  - Land use planning





TaiCCAT – Deliverables

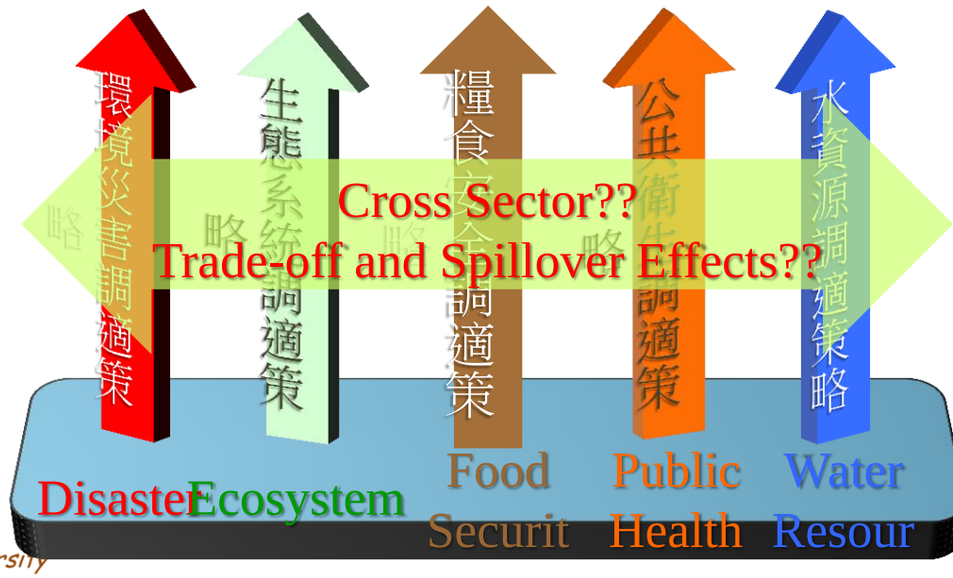
- Knowledge Platform
  - Six-step framework
  - Check list for stakeholder
  - Adaptation generator
- Assessment & Supporting Decision Tools
  - Add-on Analysis of Monitoring data
  - Cross-sectoral Vulnerability Assessment
  - Planning models to support decision making
- Demonstration Project
- National Science Reports
  - National Science Report on Climate Change Adaptation
  - Technology Roadmap

Major Tasks of WG2

- Establish directives of adaptive capacity building
- Establish SOP of climate change risk assessment for each sector
- Develop cross-sectoral system dynamics model to identify key cross sectoral problems among key issues and adaptations
- Develop cross-sectoral information protocol
- Establish vulnerability and resilience indicator systems
- Sketch cross-sectoral risk map
- Prepare science report on climate change impacts, vulnerability, resilience, and adaptation
- Establish user-friendly knowledge platform

Current Achievement

- Directives of Cross-sectoral Adaptive Capacity Building
- Summary of reviewed cross-sectoral papers and reports to enrich knowledge warehouse
- SOP of risk assessment for each sector
- Prototype of Cross-sectoral system dynamics model
- Preliminary information protocol
- Vulnerability and resilience indicator system
- Knowledge platform to generate check list and adaptation action plan



Adaptive Capacity Builder (ACB)

1 Problem Goals

2 Assessing Current Risk

3 Assessing Future Risk

4 Adaptation Options

5 Adaptation Plan

6 Monitoring Revising

Adaptive Capacity Building

ACB – 6 Steps

1
界定問題設定目標

清 單 | 文獻 | 會議 | 目標

2
評估現況風險與脆弱

Major tasks

情境 | 合成 | 水文 | 水資源 | 風險

1. 2.. 3. 4. 5.

3
評估未來風險與降[illegible]度

準則 | 排序 | 決策

4
界定/評估調適選項

修正 | 監測 | 門檻

5
規劃/執行調適措施

會議 | 評估 | 選項 | 問題

風險 | 水資源 | 驗證 | 極端

調適步驟

Procedures

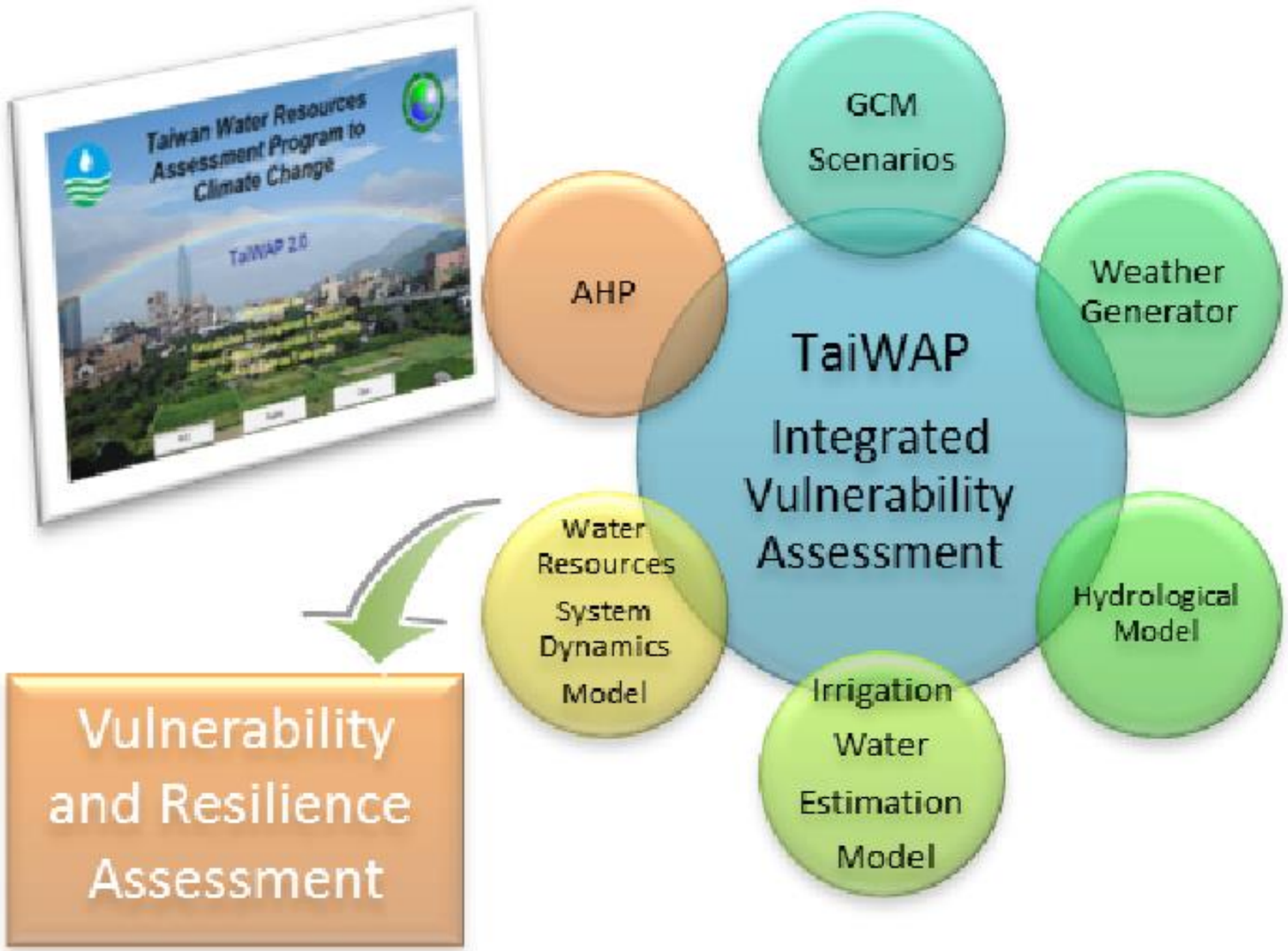
Directives of ACB

STEP	Tasks	Procedure	Data/Tool/Outputs
1.Idenfitying Problems	Provide required or optional tasks of each steps	Describe the procedure to complete each task	Describe the requirements of input data, tools, and outputs. How to use output data are also described.
2.Assessing Current Risk			
3.Assessing Future Risk			
4.Identifying/Assessing Adaptation Options			
5.Planning/Implementing Adaptation Options			
6.Monitoring and Modifying			

Tools of ACB

STEP	TOOL
1.Idenfitying Problems	Knowledge Warehouse Cross-Sectoral System Dynamics Model
2.Assessing Current Risk	SOP TAIWAP Other Assessment Tools
3.Assessing Future Risk	SOP TAIWAP Other Assessment Tools
4.Identifying/Assessing Adaptation Options	Knowledge Warehouse Cross-Sectoral System Dynamics Model
5.Planning/Implementing Adaptation Options	Multi-Criteria Analysis Trade-off Analysis
6.Monitoring and Modifying	Adaptation Tipping Points

Water Resources Assessment Tool - TaiWAP

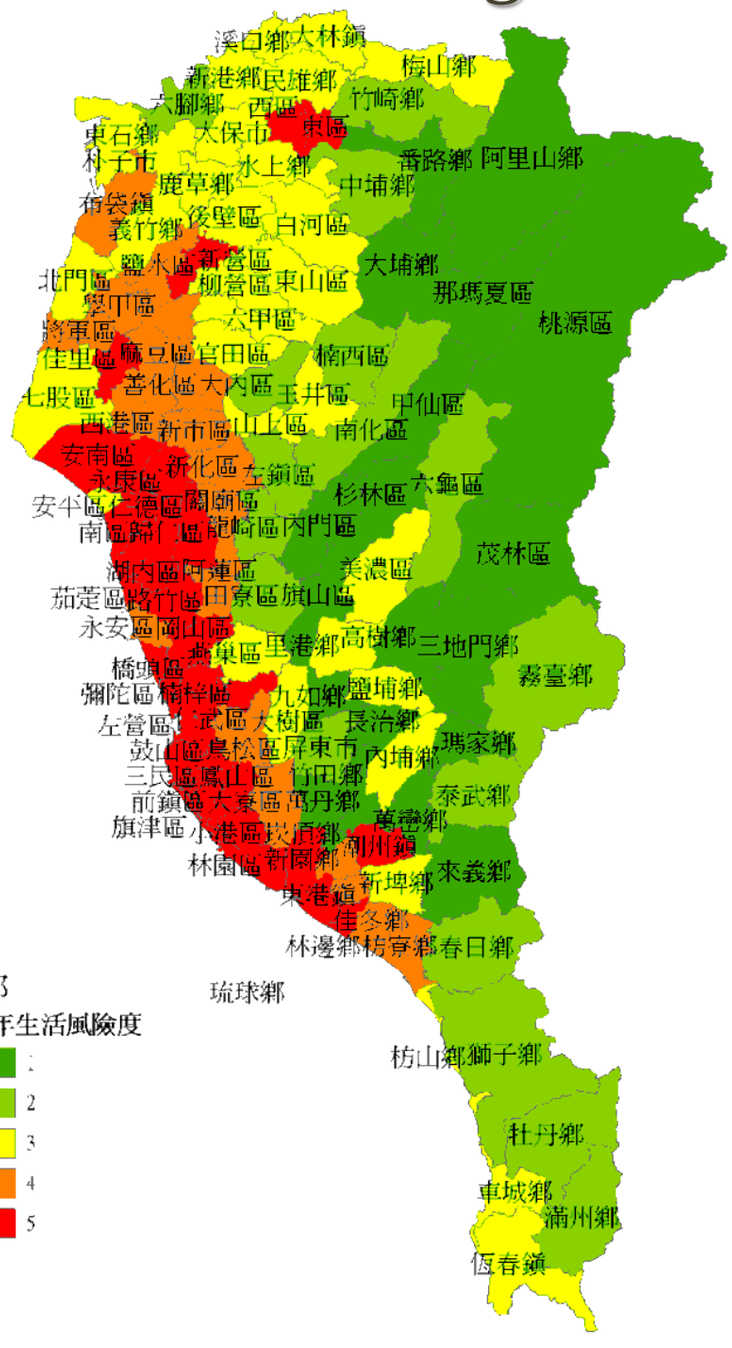


- Components
  - GCM Scenarios
  - Weather Generator
  - Hydrological Model
  - Irrigation Model
  - Water Resources System Dynamics Model
  - Multi-criterion Analysis

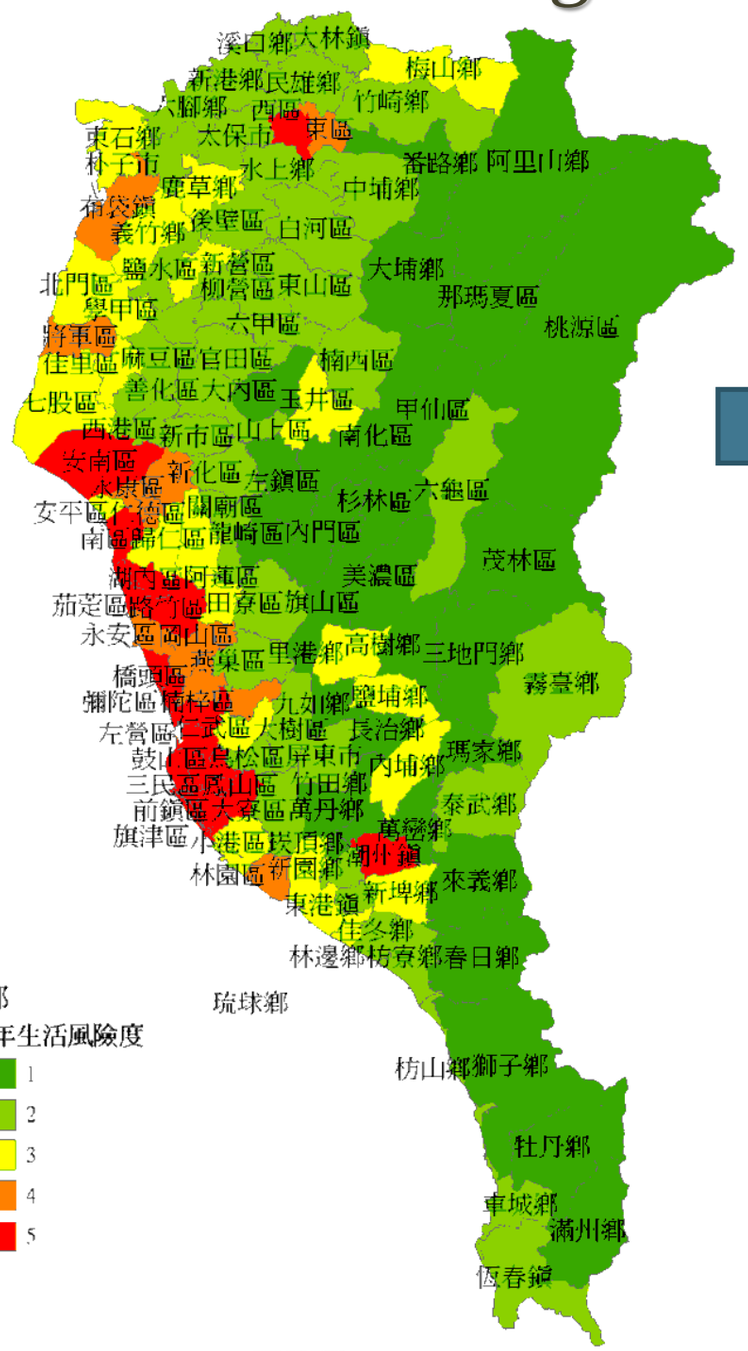
Vulnerability Maps - Domestic Water

Uses with strategies

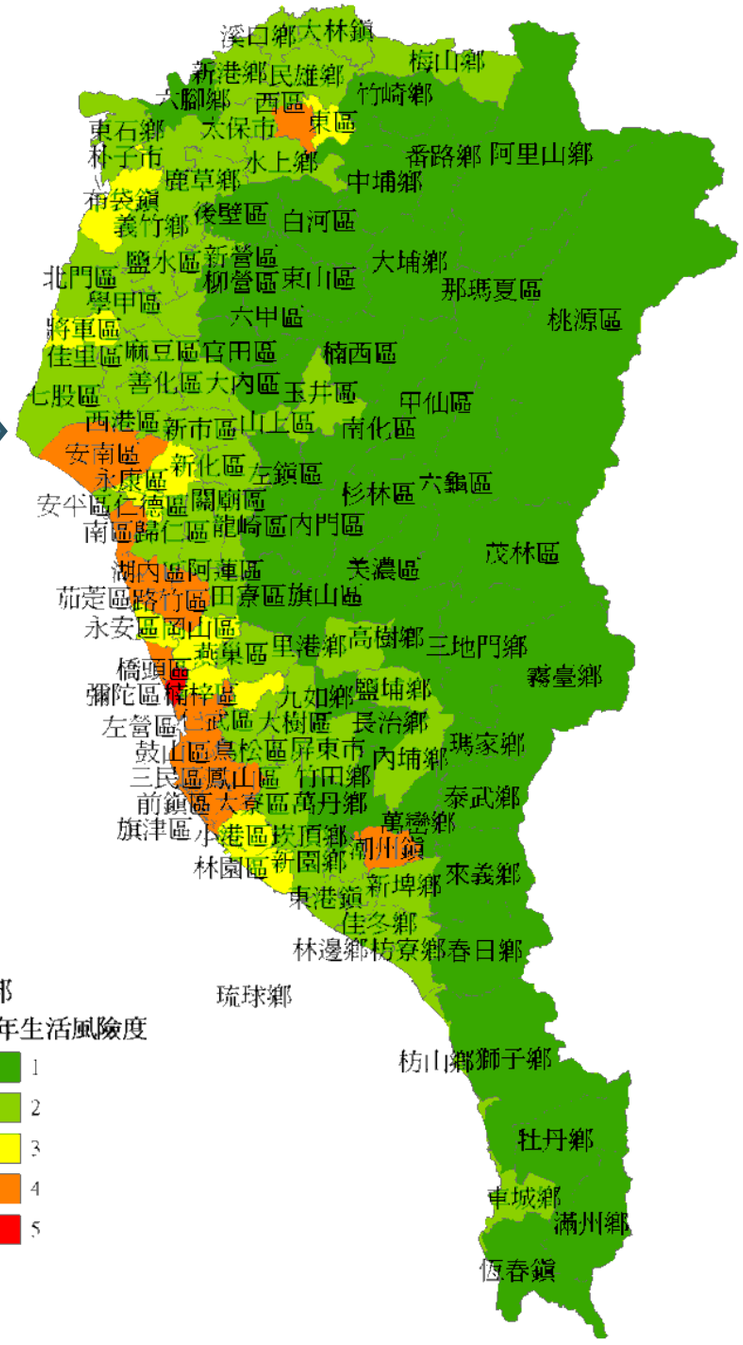
No strategies



+Planned strategies



+Strengthening strategies



Service of Knowledge Plateform

User

Demand

Service Package

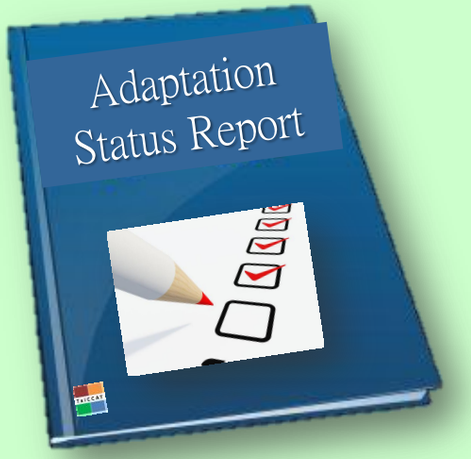
Product

- Governmental Agency
- Academic Society
- General Public

1. Problem/Goal
2. Current Risk
3. Future Risk
4. Adaptation Options
5. Adaptation Plan
6. Monitoring & Revising

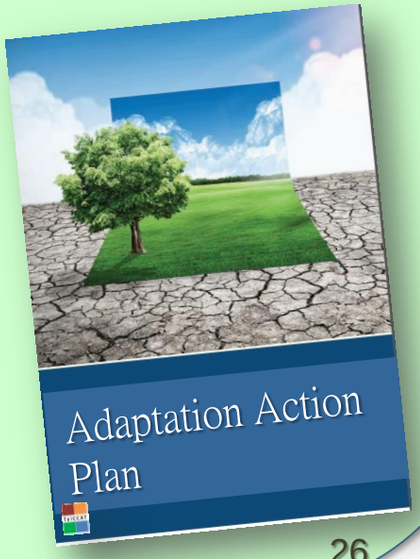
產出

Checklists of Adaptive Capacity Building

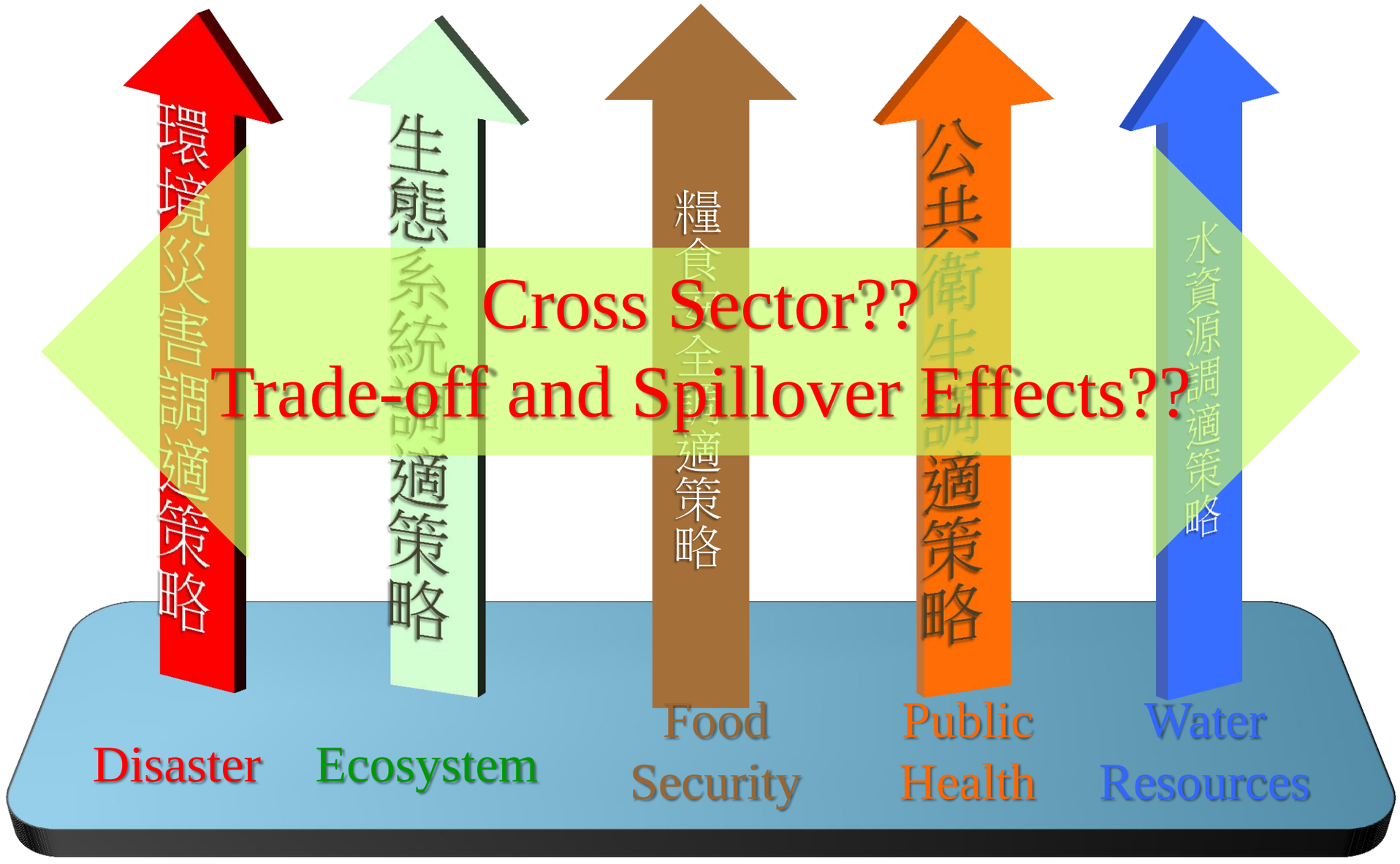


- Procedure
- Data
- Tools
- Information
- Knowledge

Adaptation Action Plan Generator



Conventional Single Sector Approach



Cross-Sectoral Approach

Water

Food Security

Public Health

Eco-system

Disaster

?

?

Water

Public Health

Food Security

Eco-system

Disaster

Cross-sectoral Analysis of ACB

STEP	Cross-sectoral Analysis
1.Idenfitying Problems	Identify key cross-sector issues and their major drivers
2.Assessing Current Risk	Evaluate current cross-sectoral risks and consider synergies among sectors
3.Assessing Future Risk	Evaluate future cross-sectoral risks and consider synergies among sectors
4.Identifying/Assessing Adaptation Options	Identify the relationships between adaptation measures
5.Planning/Implementing Adaptation Options	Synergy and Trade-off Analysis, and Multi-Criteria Analysis, including the criterion of complexity of cross-sector relationships
6.Monitoring and Modifying	Adaptation Tipping Points

Stakeholder Engagement of ACB

STEP	Engagement
1.Idenfitying Problems	Local concerned issues
2.Assessing Current Risk	
3.Assessing Future Risk	
4.Identifying/Assessing Adaptation Options	Local knowledge and preference of adaptation measures
5.Planning/Implementing Adaptation Options	Preference of pathway
6.Monitoring and Modifying	Local monitoring program

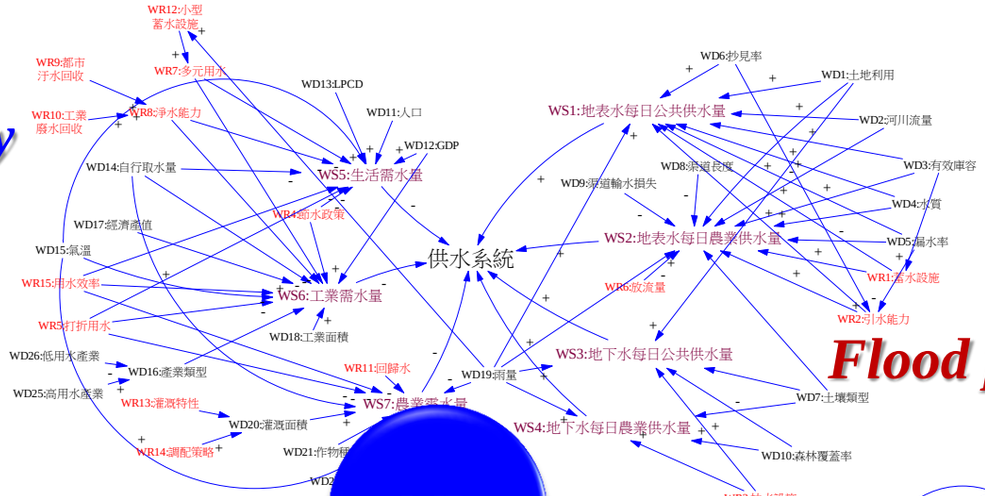
Cross-Sectoral System Dynamics Model

Goals

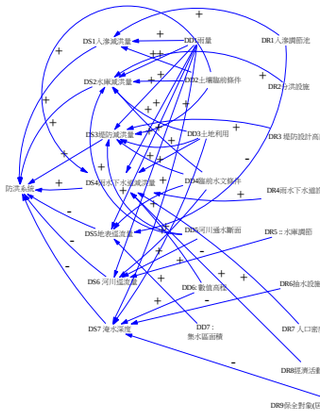
- Stage I (2012~2014)
  - Developing cross-sectoral system dynamics model to identify the relationships between different sectors' factors.
  - Supporting adaptation decision making to identify stakeholders and trade-off and spillover effects among different sectors' adaptation strategies.
- Stage II (2014~2016)
  - Enhance cross-sectoral system dynamics model to quantify cross-sectoral risk and resilience.

System Dynamic Model for Each Sector

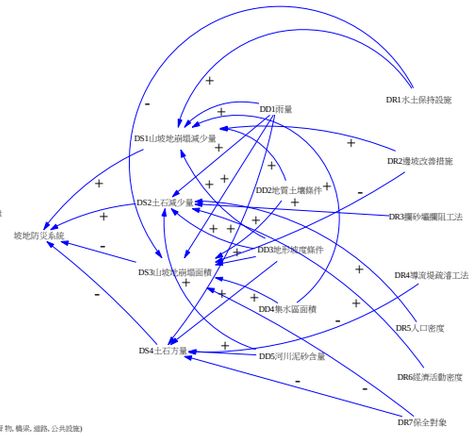
Water supply



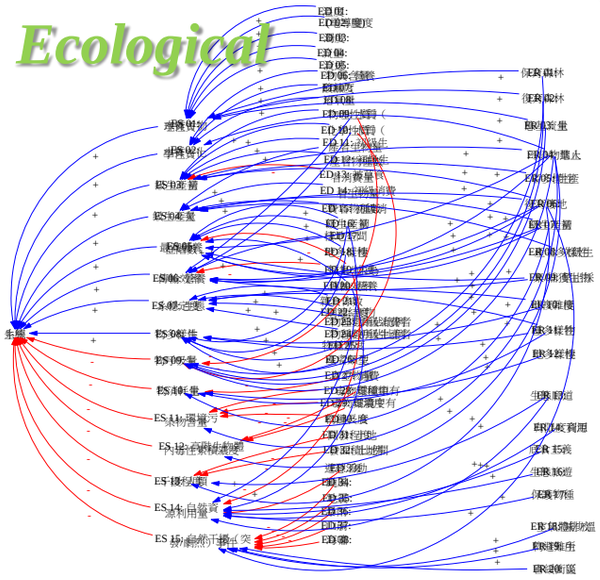
Flood protection



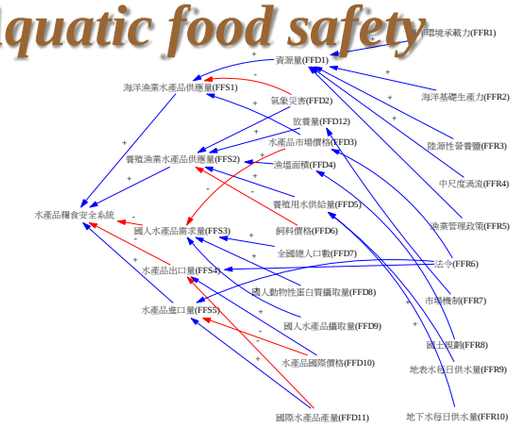
Slope disaster prevention



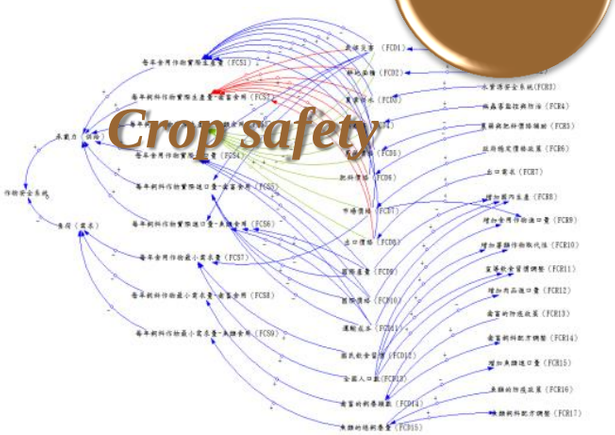
Ecological



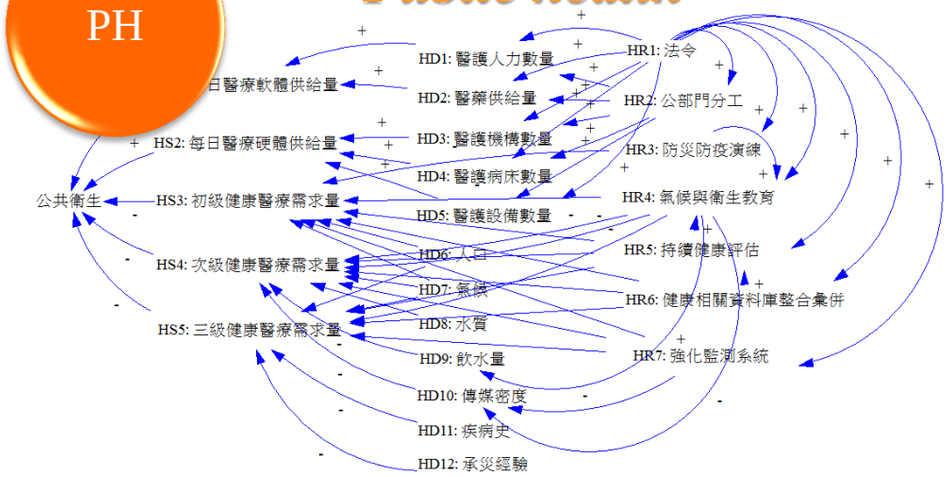
Aquatic food safety



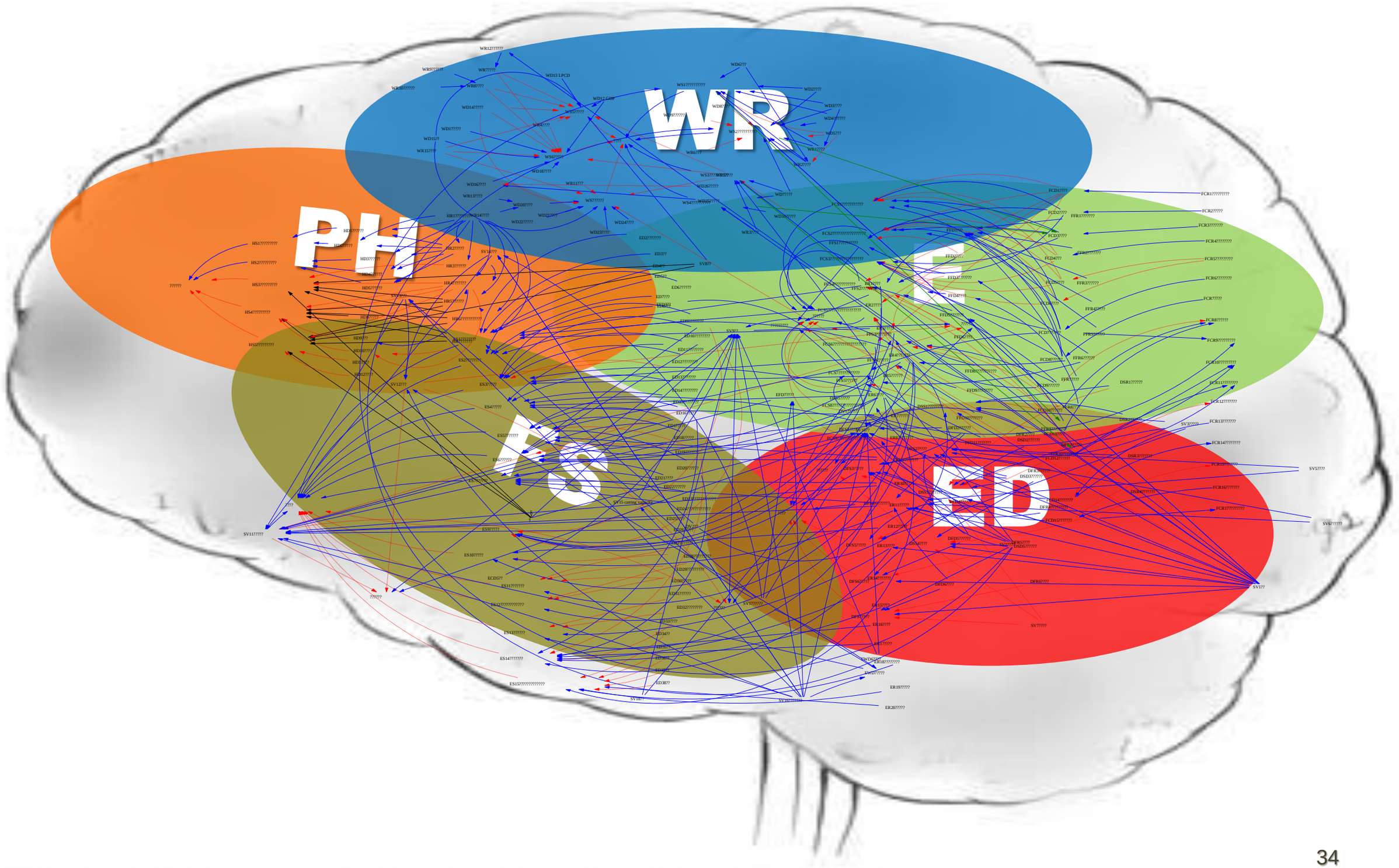
Crop safety



Public health

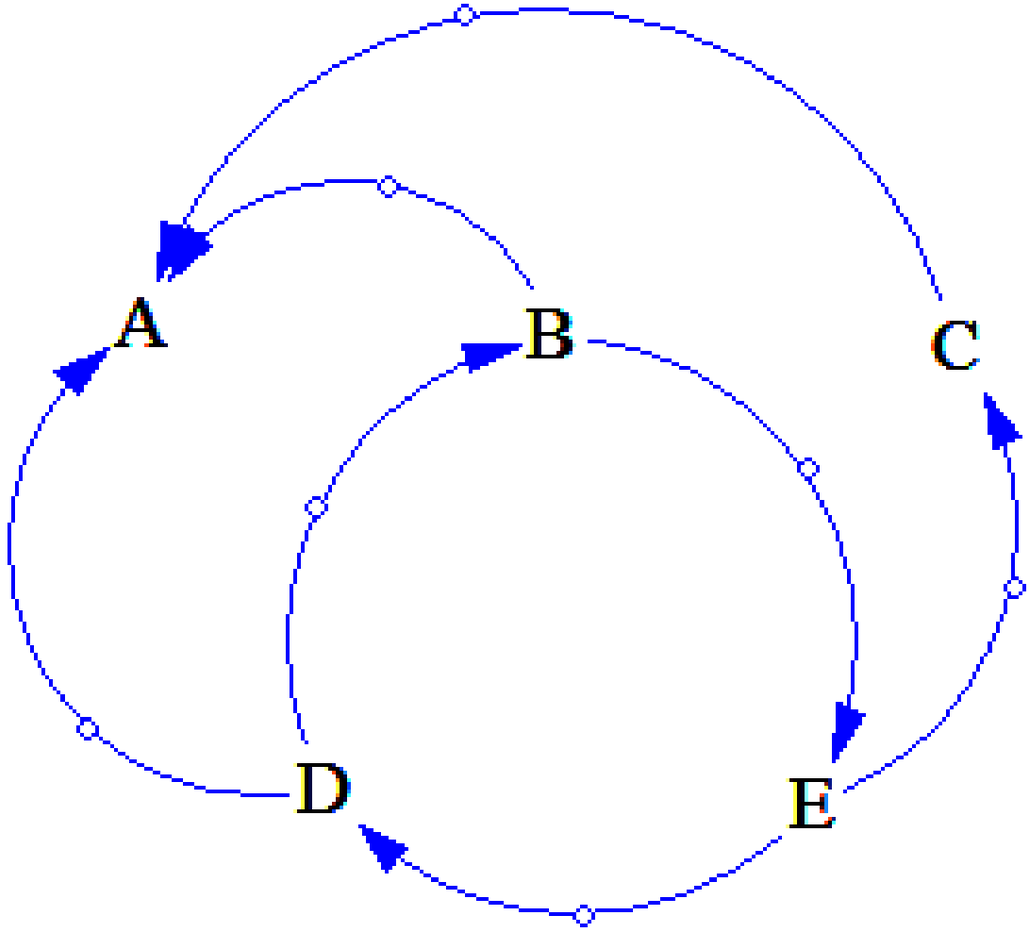


Cross Sectoral System Dynamics Model



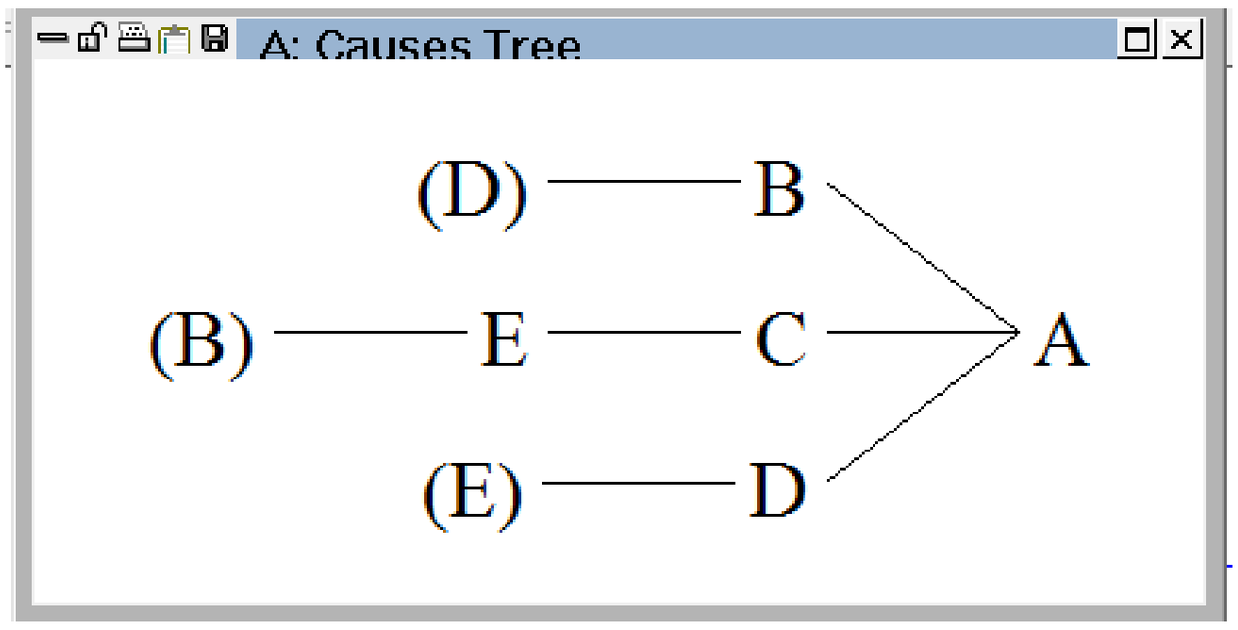
Tool: Vensim System Dynamics modelling

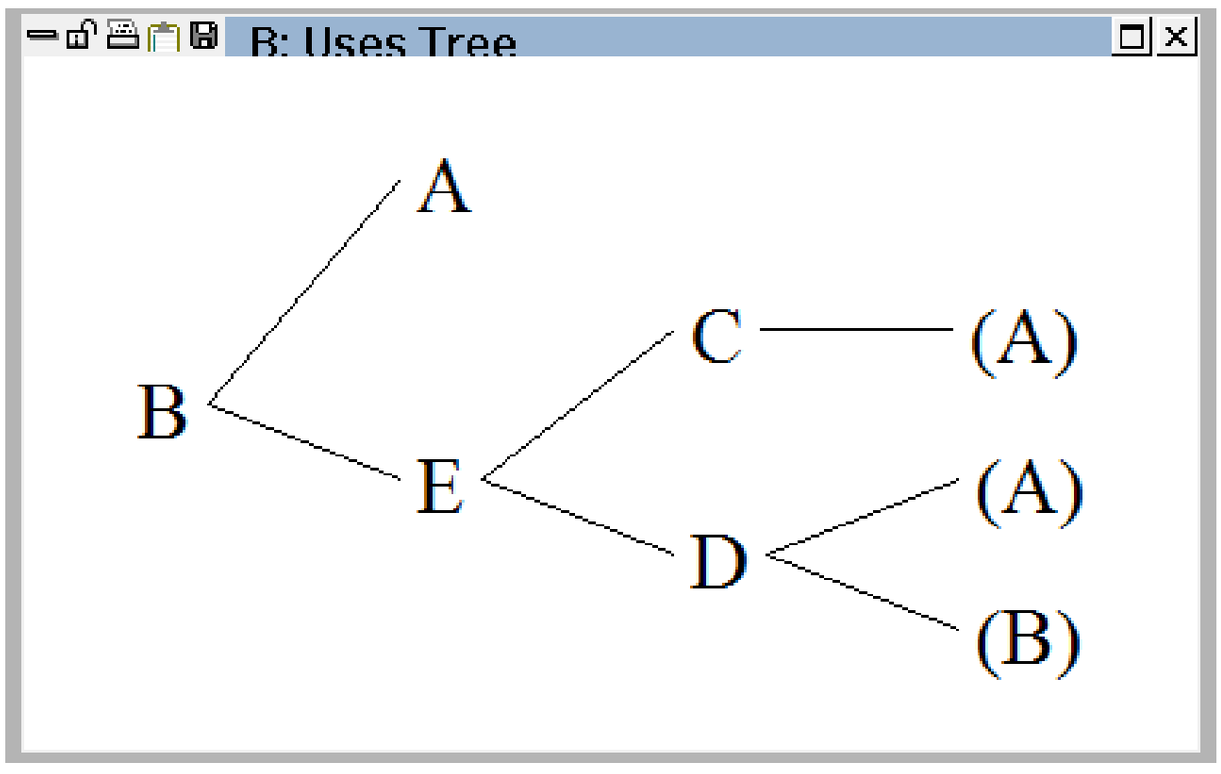
- If there is a simple system dynamics model as below, the analyses of causes tree and uses tree can be applied to identify the relationship between factors.



Vensim model example

- Causes tree of A and uses tree of B





*( ) means repeat

Water Action

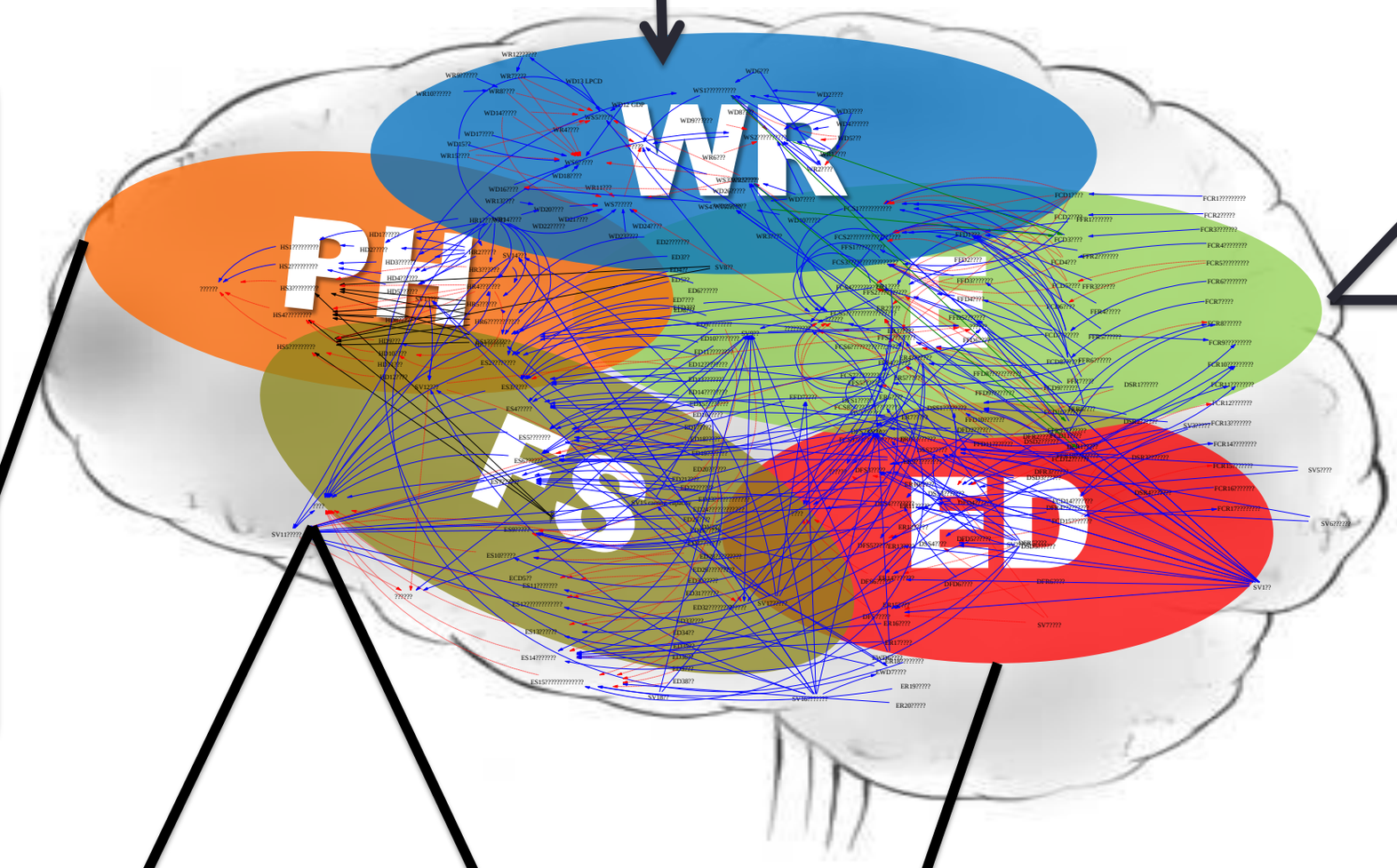
W.Driver 1 | W.Driver 2 | ... | W.Driver N

P.Driver 1

P.Driver 2

...

P.Driver N



E.Factor 1

E.Factor 2

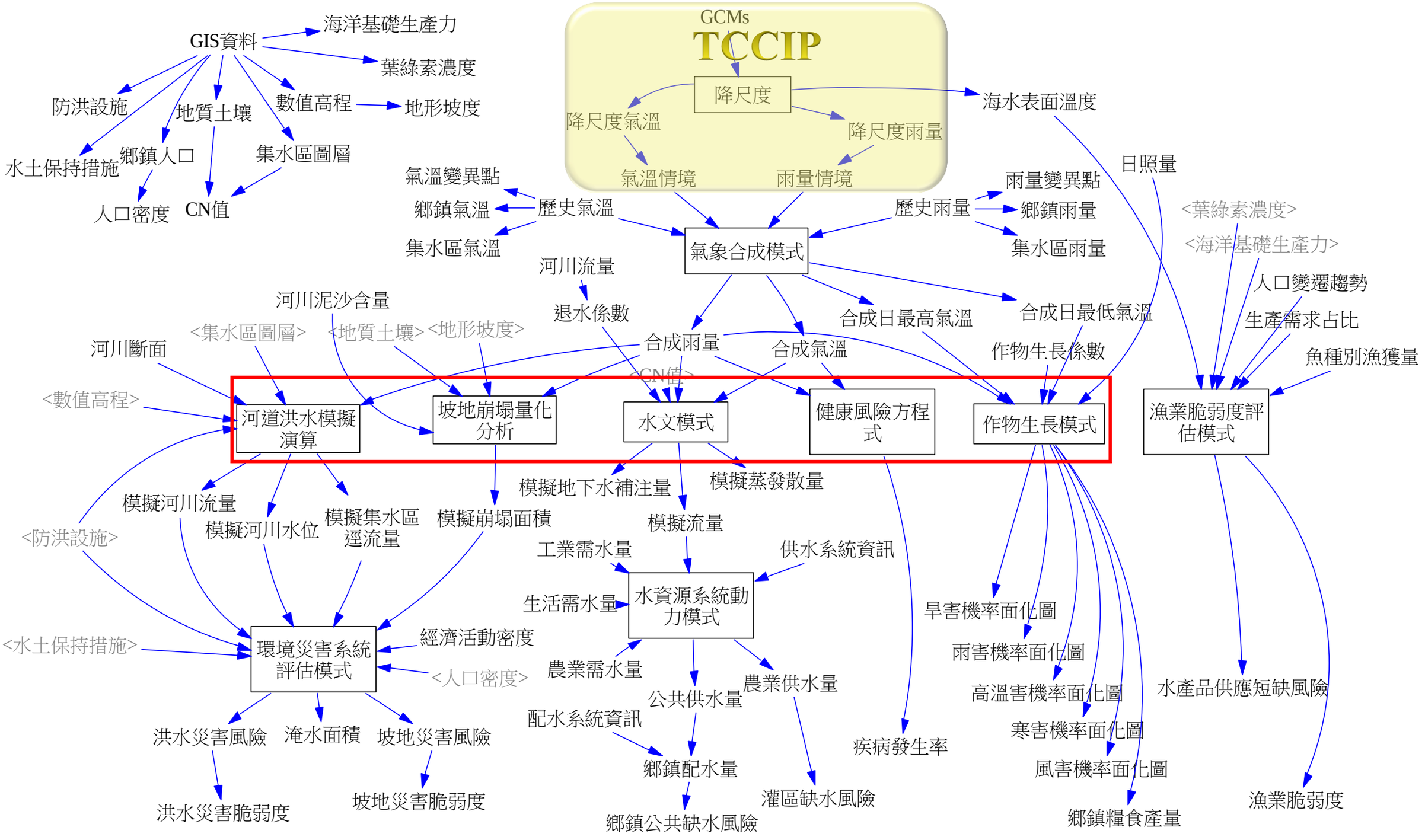
...

E.Factor N

F.Driver 1 | F.Driver 2 | ... | F.Driver N

D.Driverr 1 | D.Driver 2 | ... | D.Driver N

Information Flow



Vulnerability and Resilience Indicators

Design of Indicator Systems
- Sustainable Development as Core Criterion

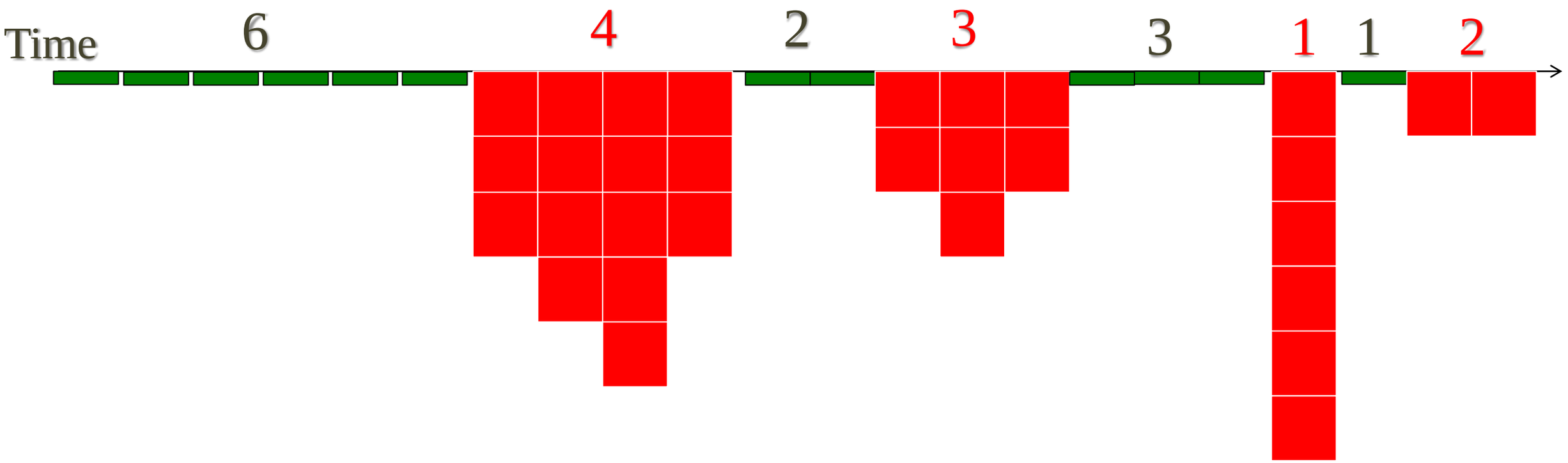
- Meet both current and future generations' needs without exceeding environmental carrying capacity.

- Loadings (Consumption or Demand) should not exceed carrying capacity (Service).

Time to Failure and Time to Repair

Function : Loading ≤ Carrying Capacity

Failure :Loading > Carrying Capacity



- Time to Failure, TTF : Duration of function = 6, 2, 3, 1
- Time to Repair, TTR : Duration of failure = 4, 3, 1, 2
- Total Cumulative Deficits of three events = 15, 7, 6, 2
- Max. Deficit of a time period = 6

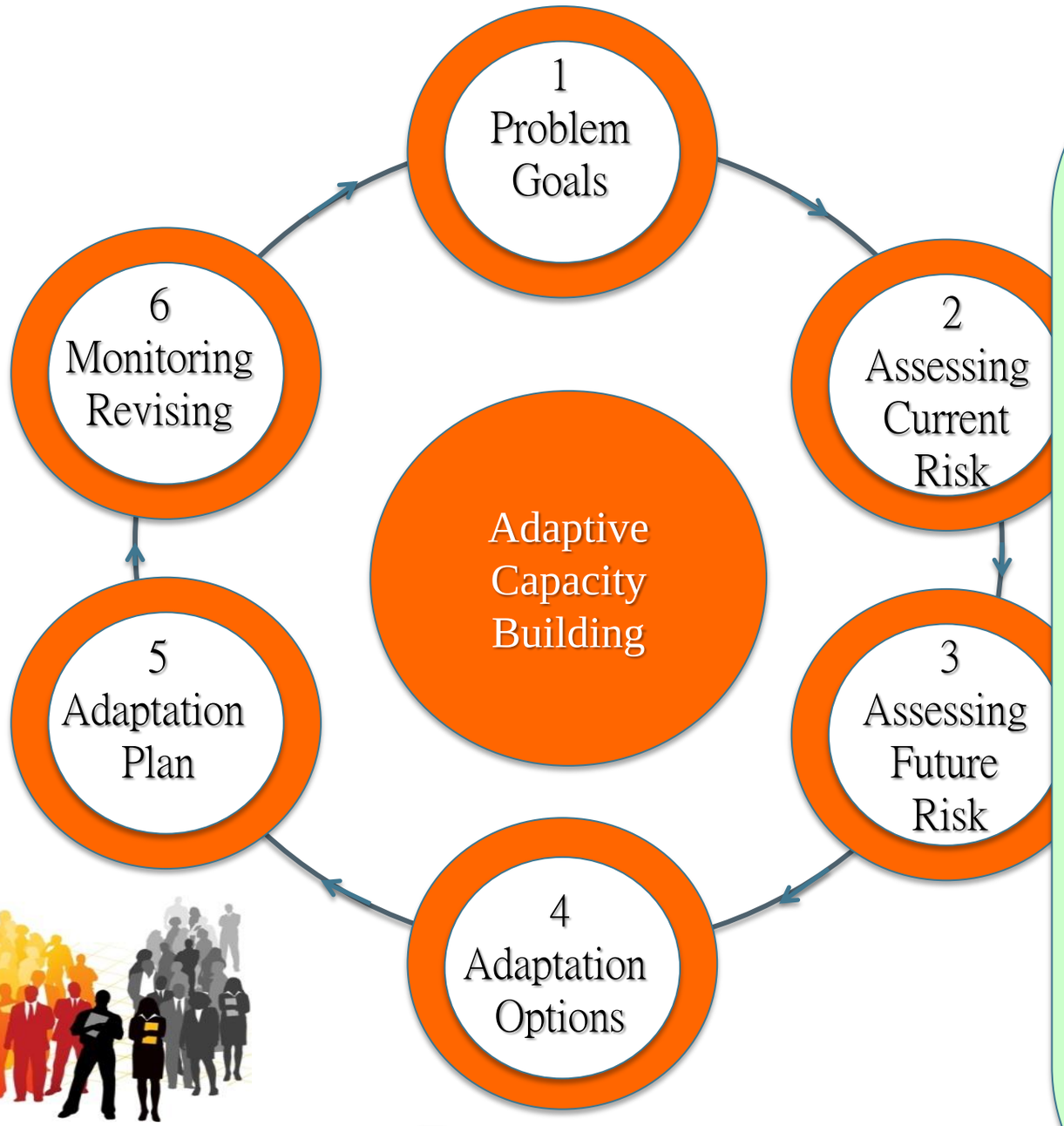
Definition of Indicators

Resilience	Definition	Example
Res_Indicator 1	Mean Time to Repair, MTTR	Average(4, 3, 1, 2) = 2.5
Res_Indicator 2	Max. TTR	Max(4, 3, 1, 2) = 4

Availability	Definition	Example
Ava_Indicator	MTTF/(MTTR+MTTF)	3/(3+2.5) = 0.545

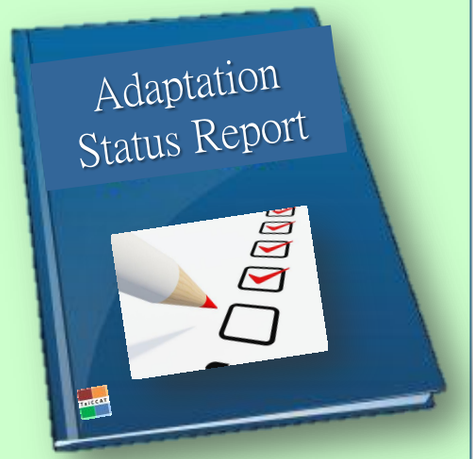
Vulnerability	Definition	Example
Vul_Indicator 1	Max. total cumulative deficits	Max(15, 7, 6, 2) = 15
Vul_Indicator 2	Max. deficits for a time step	6

Adaptive Capacity Builder (ACB)



Service Package

Product



Checklists of Adaptive Capacity Building

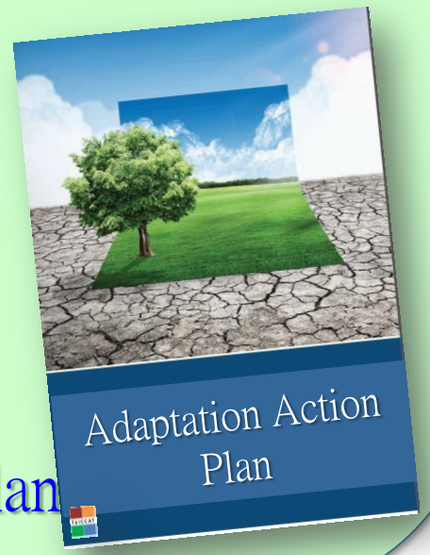
Procedure

Data

Tools

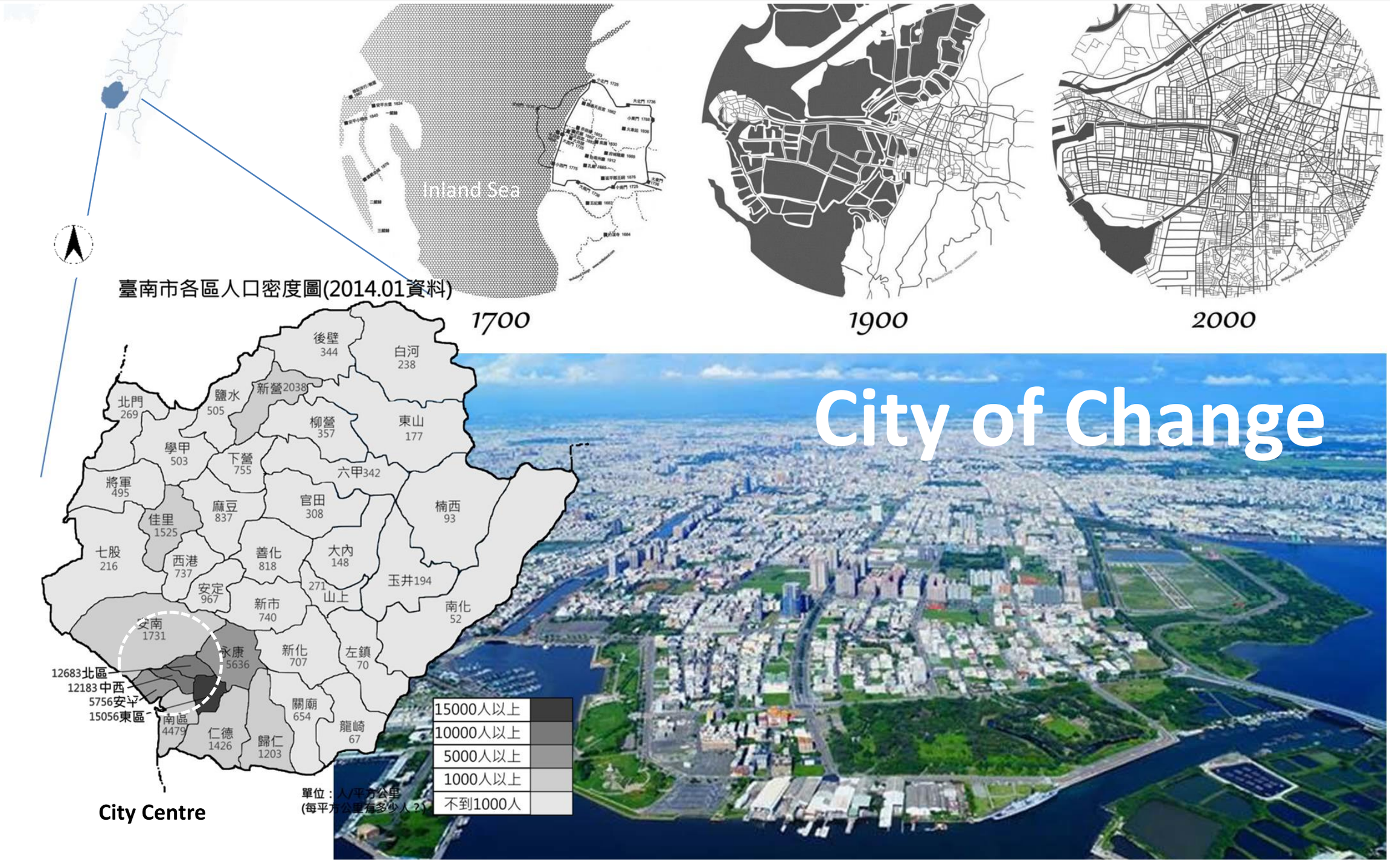
nformation

Knowledge



Adaptation Action Plan Generator

Demonstration Project—Tainan



Final Remarks

- Resilience building is the most crucial issue since climate change may bring more frequent extreme events.
- The issues related to cross-sector, different spatial scales, and multi-level governance are very important.
- TaiCCAT has worked hard to establish an adaptive capacity builder with six steps and a knowledge platform to support risk assessment and resilience building. It not only provides directives but also tools to complete each tasks.

Smart Living with Changing Climate!

Thank you for your Attention!

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