

World Vision Forum, IWHR, 14 June 2018

# Water-related Disaster Management in Japan and Transdisciplinary Approach

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Since 1949 (1795)

Core of the Region and Human Resources for the Globe

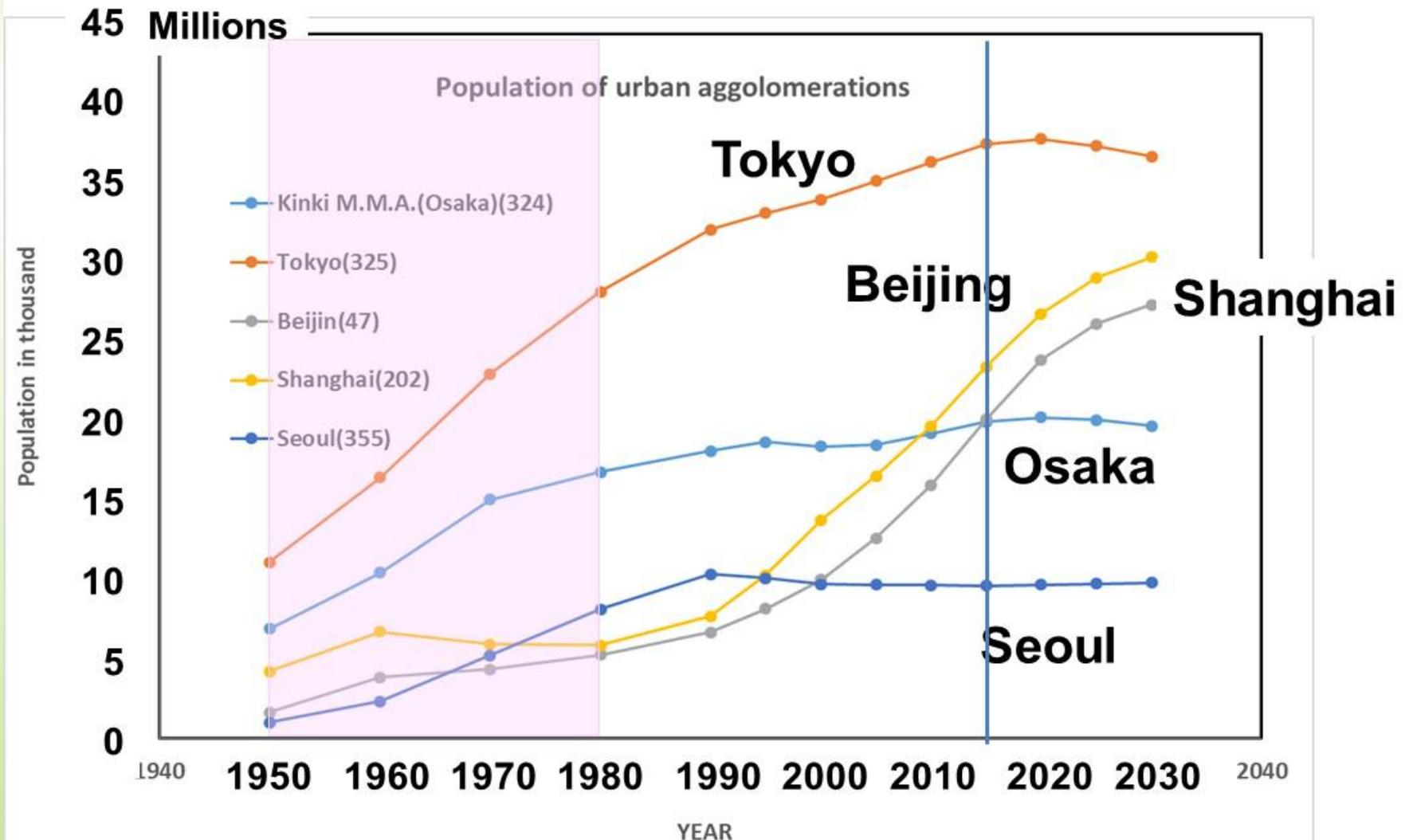
Education, Engineering, Medicine, Life and Environmental Sciences



Department of Civil and  
Environmental Engineering  
Interdisciplinary Center for River Basin  
Environment

Dr. Satoshi Ohmura, 2015 Nobel Prize in Physiology or Medicine

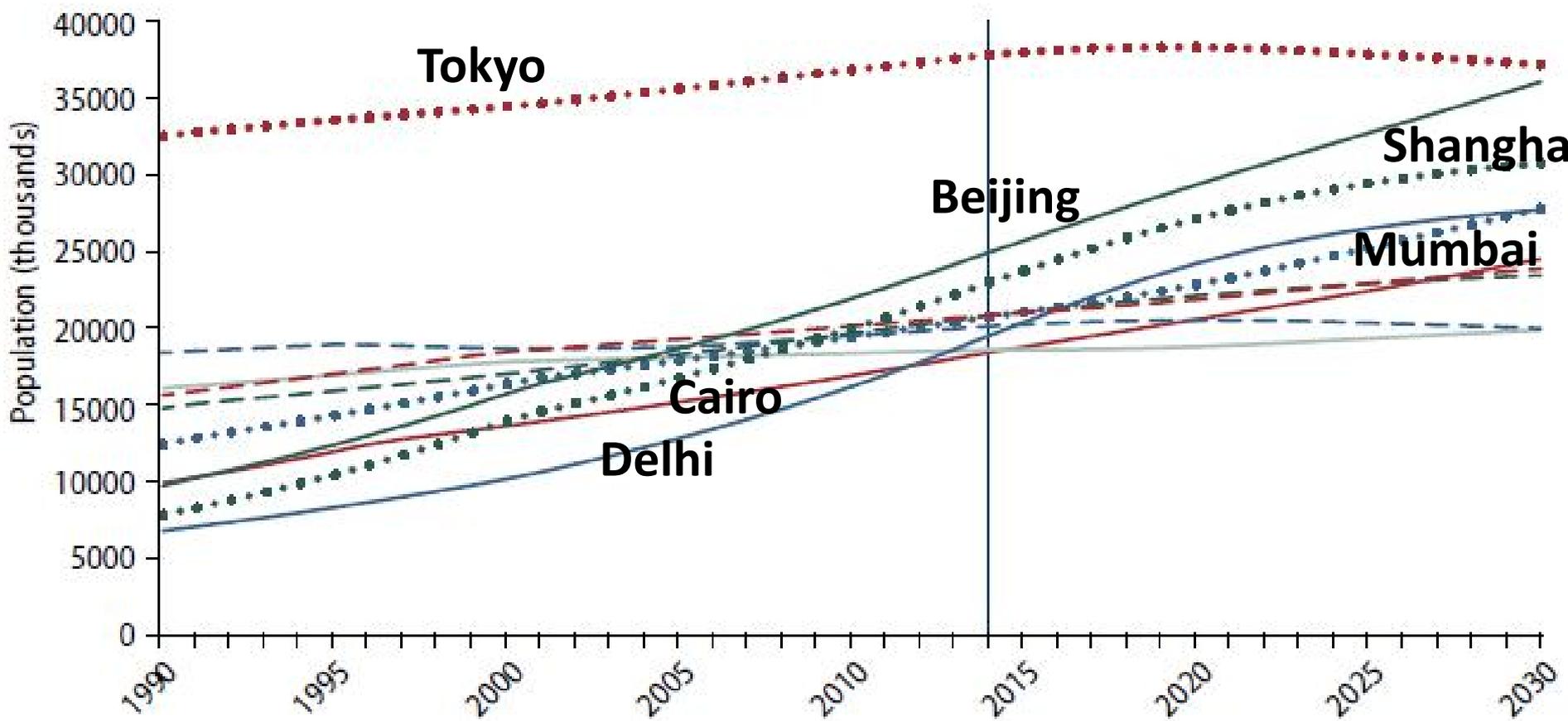
# Very rapid urbanization/industrialization



After: UNDESA Population Division (2015) World Urbanization Prospects:  
The 2014 Revision, ST/ESA/SER.A/366

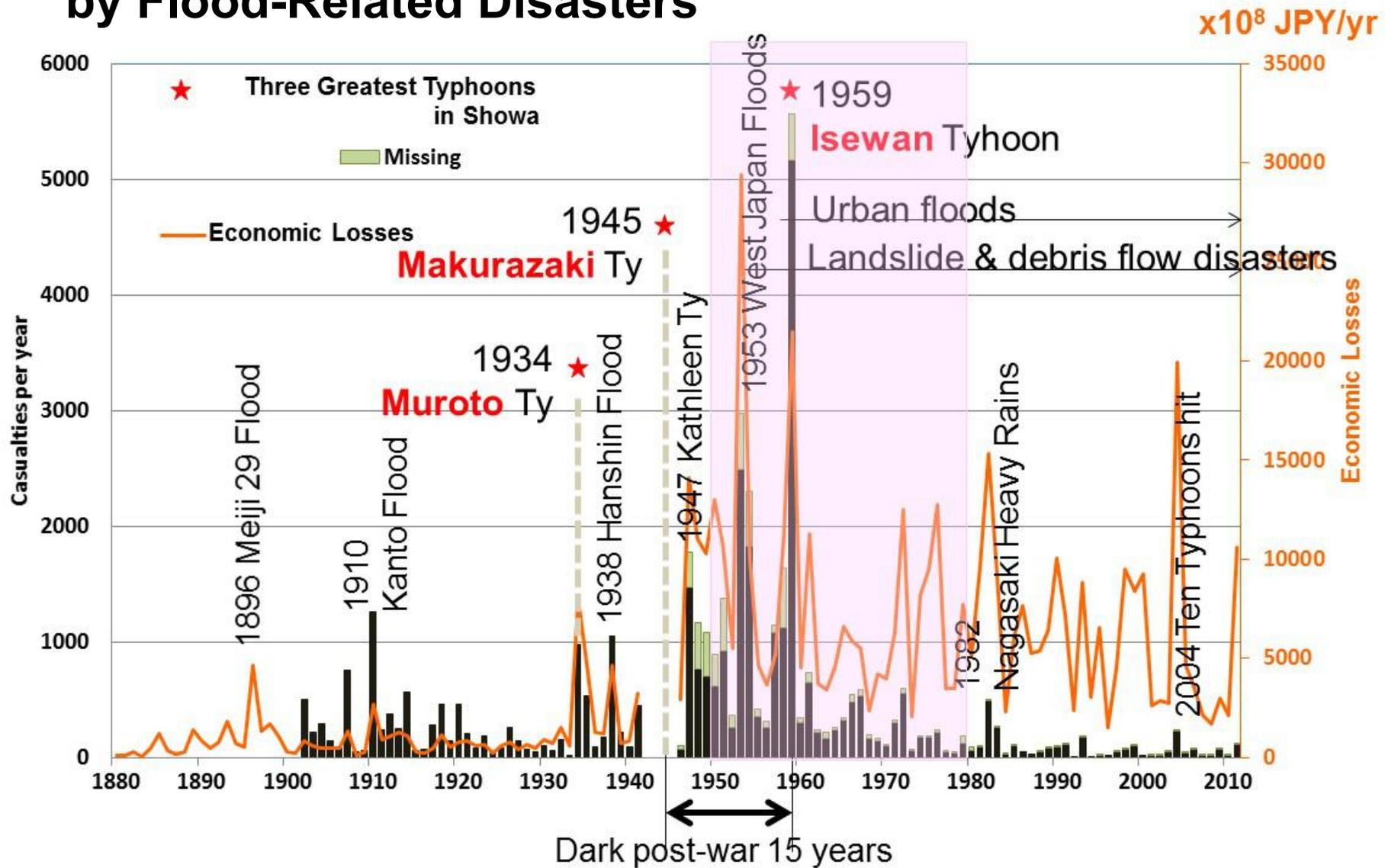
Figure 9.

The ten largest urban agglomerations in 2014 show varied growth patterns both in the recent past and in future projections



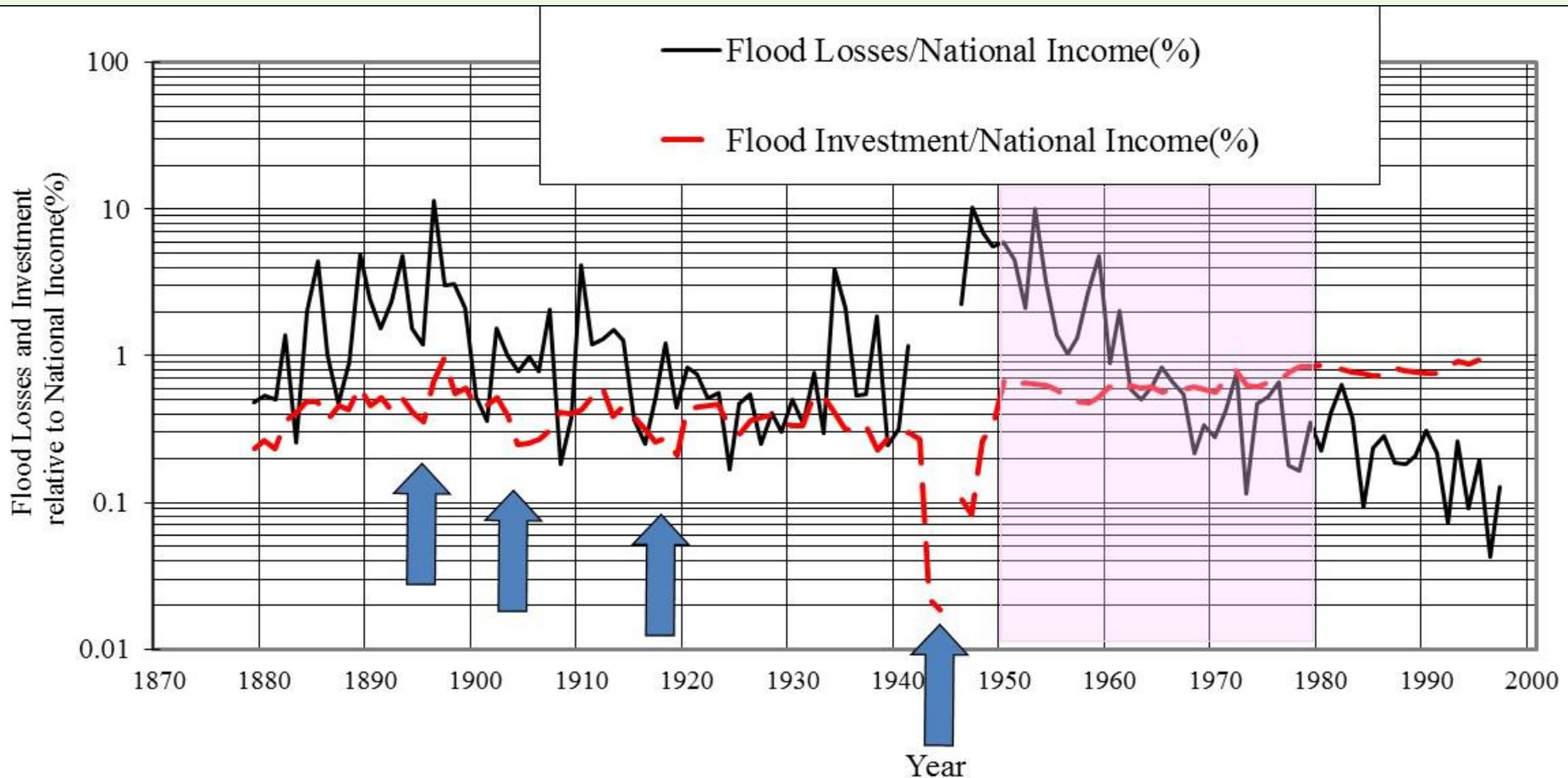
After: UNDESA Population Division (2015) World Urbanization Prospects: The 2014 Revision, ST/ESA/SER.A/366

# Dead & missing and economic losses (2005 value) by Flood-Related Disasters

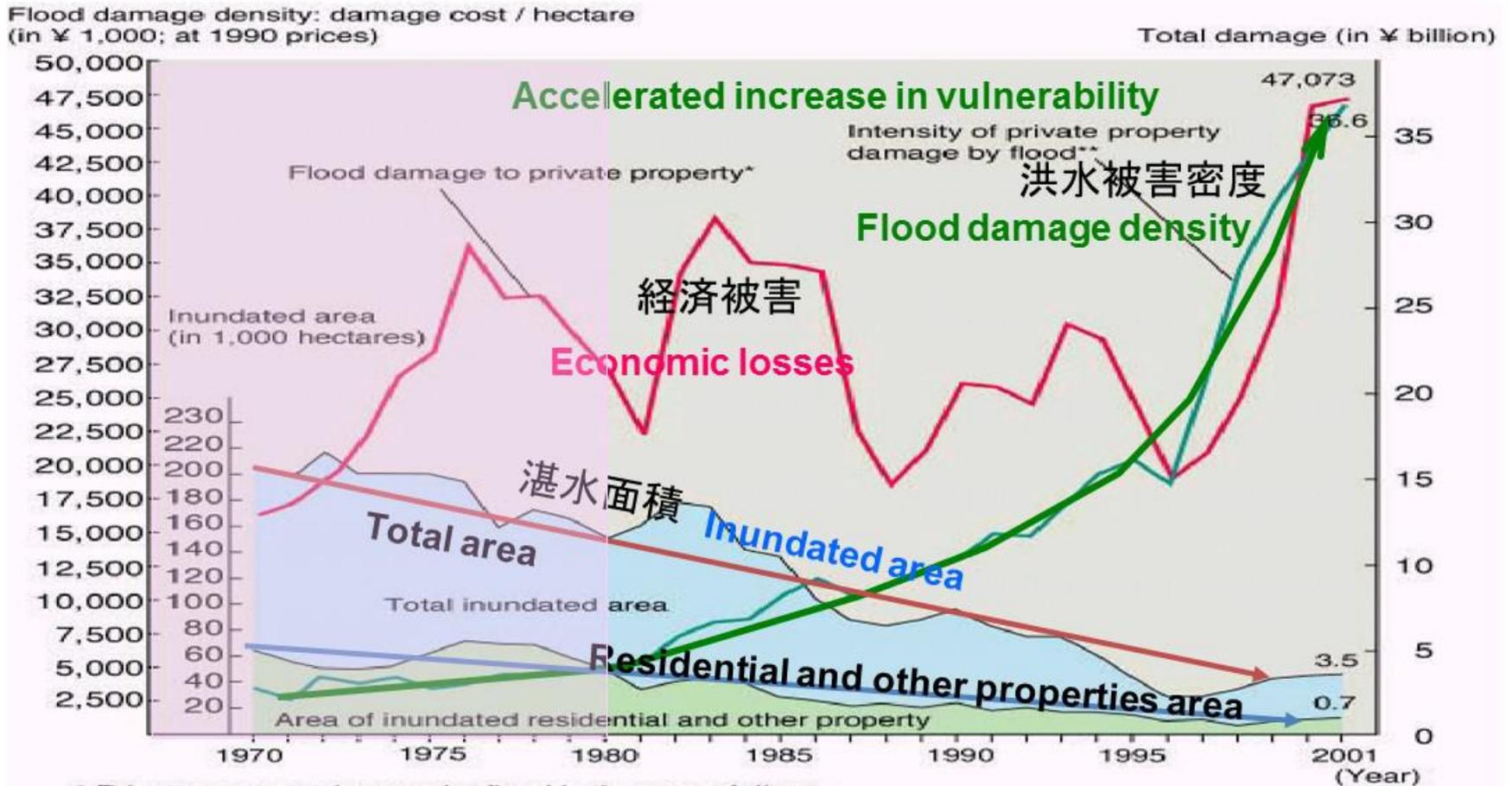


Data Source: MLIT Water Disaster Statistics, 2013

# Flood losses and investments



# Increase of flood damage potential



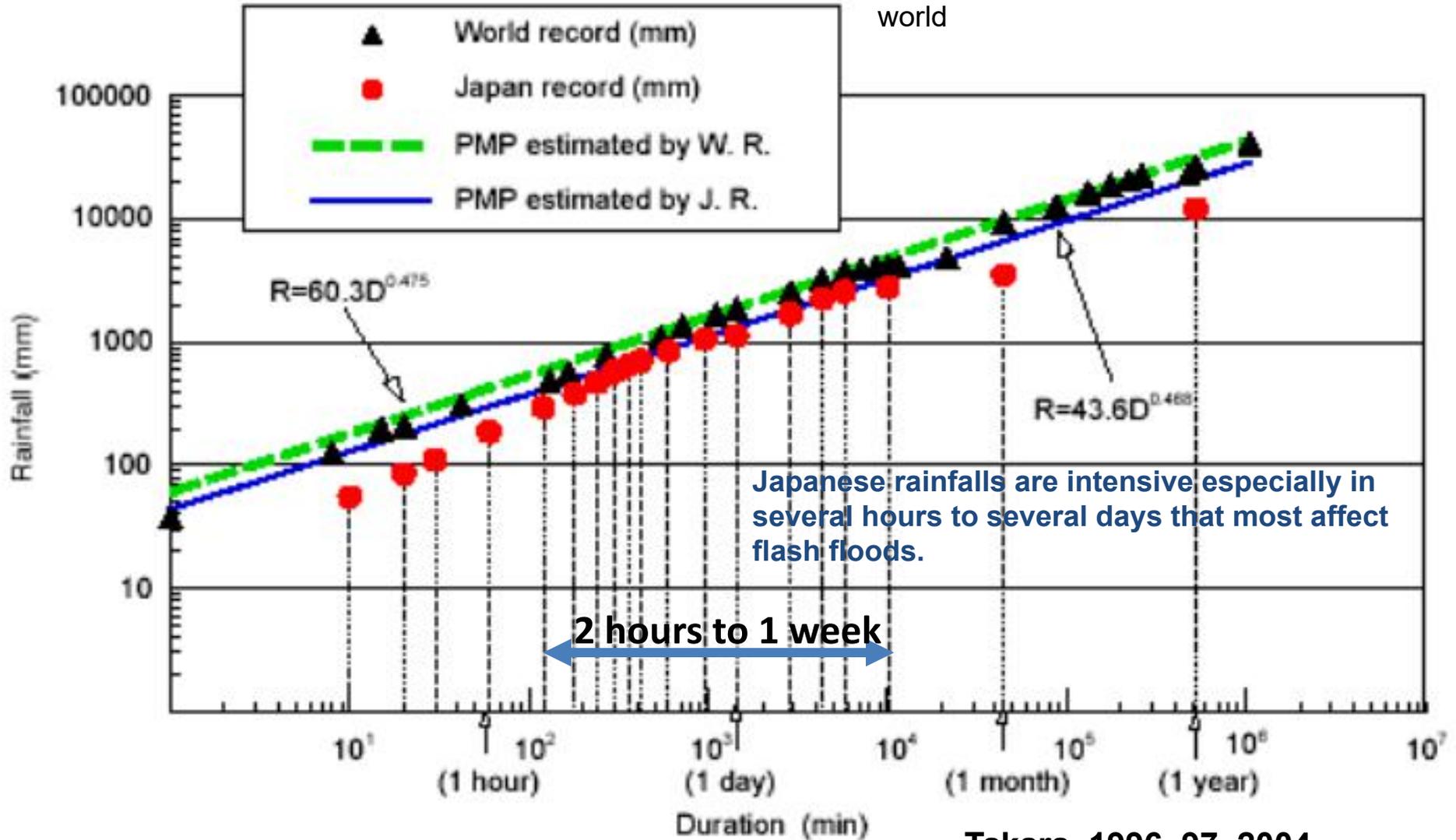
- \* Private property damage by flood is the sum of direct damage plus loss due to interruption of business.
- \*\* Density of private property damage by flood is calculated by dividing the private property damage by the area of inundated residential area.



The Kano River at Numazu, MLIT

- Heavy rain
- Steep Mountains
- Narrow basins
  - Small dams
  - Much sediment
- Rice paddies
- Dense population

Maximum Precipitation records of the world

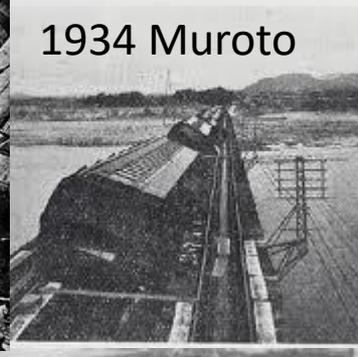
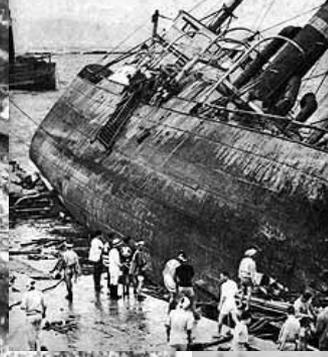


Japanese rainfalls are intensive especially in several hours to several days that most affect flash floods.

2 hours to 1 week

Takara, 1996, 97, 2004

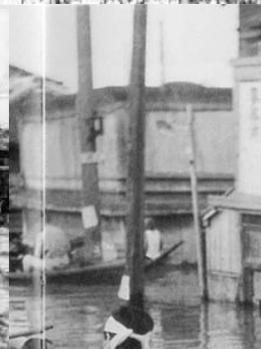
世界および日本の豪雨記録とそれに基づく可能最大降水量(PMP)の推定線 [Takara et al. (1996) または水文・水資源ハンドブック(1997, p. 230)に記載の図をデータ更新により修正]



1934 Muroto



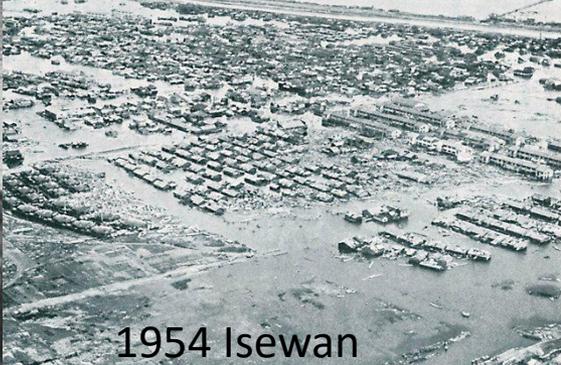
1938 Hanshin



1945 Makurazaki



昭和22年、大きな被害を与えたカスリーン台風(共同通信社提供)



1954 Isewan

昭和22年、大きな被害を与えたカスリーン台風(共同通信社提供)



伊武川村山高地内の大武川  
荒廃状況



1947 Kathleen  
flood people in the  
drums fastened with



阪神 阪神 室戸 室戸 室戸  
筑後川 阪神 枕崎  
筑後川 伊勢湾 キャサリン 伊勢湾  
一関 富士川 富士川 斐伊川

# Statutory Evolution

- M29 • 1896 River Law (FC, water allocation)
- 1962 Disaster Countermeasures Basic Act
- S39 • 1964 River Law (FC, WRD) Multi-p dams law
- **1977 Comprehensive Flood Control Measures** (storage, infiltration, EW, HMap)
- 1987 High-standard levees (super levees)
- H9 • 1997 River Law (FC, WRD, Env)
- **2000 Basin resistance to floods** (allow inundatn)
- **2000 Sediment disasters prevention law** (relocation suggestion)

# River laws

- Meiji 29 • **1896 Law (after serious floods):** FC was basically local responsibility but national if necessary. **Historical agricultural water use** was authorized. 3 FC laws (river, sabo & forest)
- Showa 39 • **1964 Law (with wrd):** **Basin-wide** river management, 109 class A rivers managed by national G & class B by local G. **Water resource development** (ws, mp-dams & hp).
- Heisei 9 • **1997 Law (with env & citizens):** River management basic policy (national council) & implementation plan (Local multi-stakeholder river basin committee, public hearing). **Environmental** flow, ecol. conservation.

1977

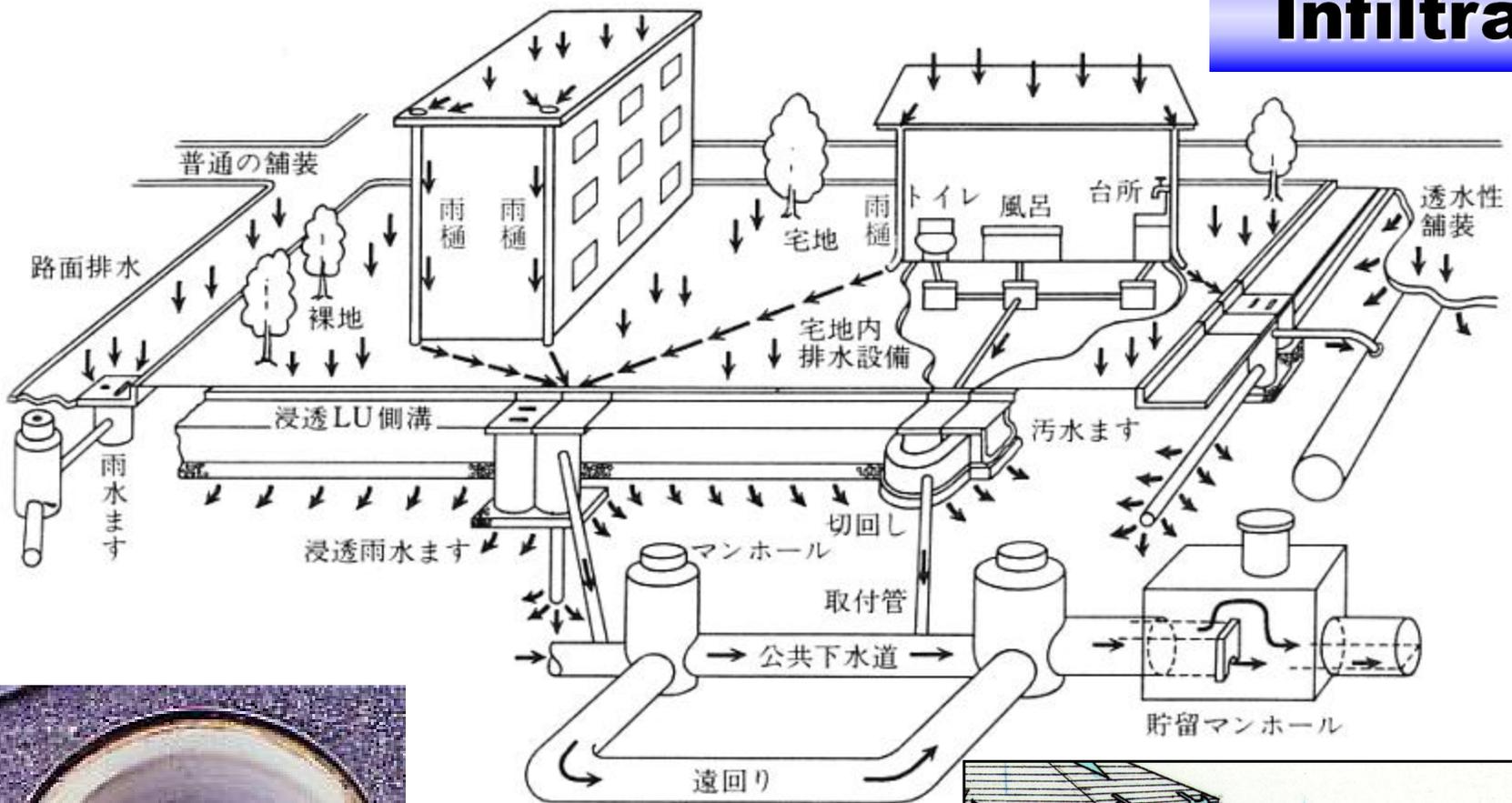
# Comprehensive FC Measures

Recommendation by River Council of MOC

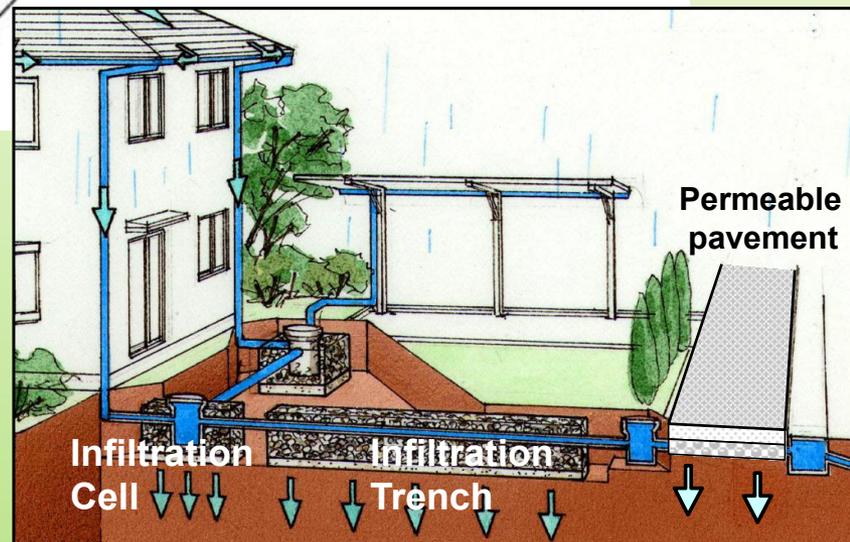
- In rapidly developing basins, in addition to ***traditional*** flood control measures,
- Make land development add **no increase of rainfall discharge** by promoting ***infiltration & storage***.
- Radar rainfall measurements & information dissemination: **FRICS** (Federation of river integrated communication systems) was established.
- Prepare & publicize **Hazard Maps** (F & land failure).
- Identify urgent targets to be met, etc.

Sponge  
City

# Infiltration



**Infiltration Cell**



# Flood retardation ponds

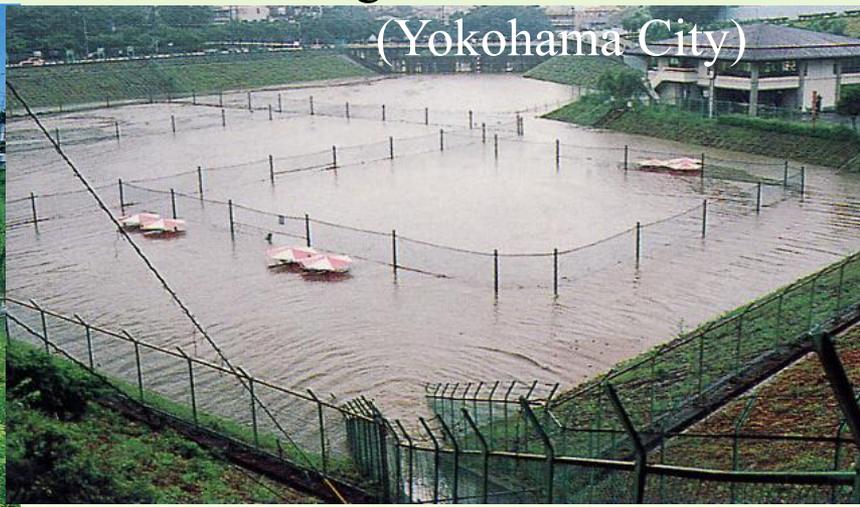
Slide by Kehin Koji, MLIT

## Storage Measures

## Kirigaoka retardation Pond

(Yokohama City)

Usual status

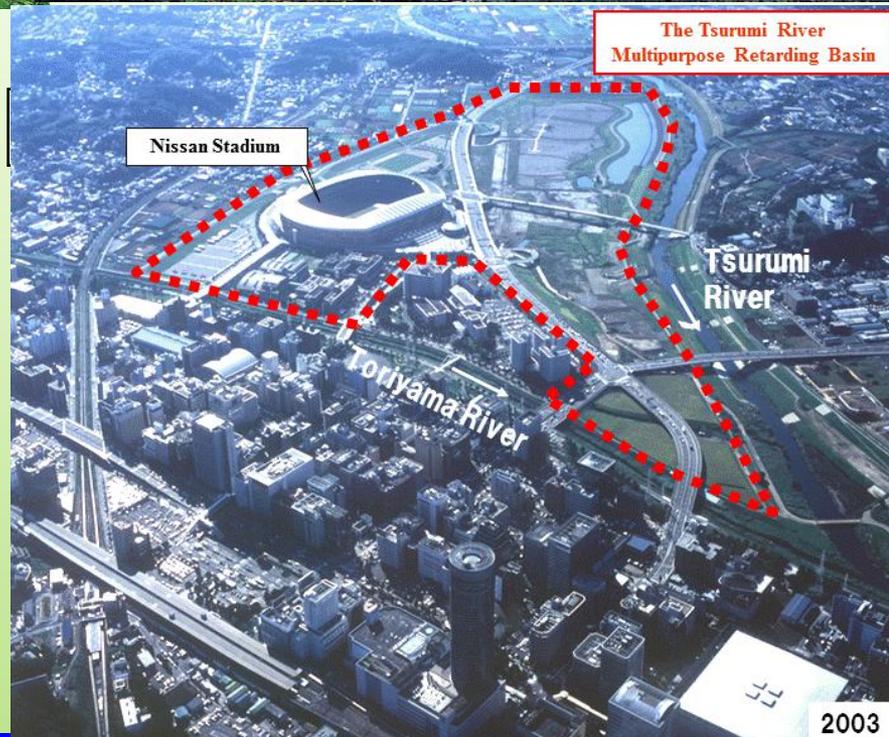


▲ The Example of the Multi Purpose Pond  
The Pond is normally used as tennis courts

▼ Storage at School Playground



Confluence of Tsurumi  
& Toriyama Rivers



The Tsurumi River  
Multipurpose Retarding Basin

Nissan Stadium

Tsurumi  
River

Toriyama River

# Comprehensive Flood Control Measures

1977

Slide by  
Kehin Koji,  
MLIT



Preservation of green areas

Urbanization control

Landfill control

Channel Improvements

Retardation Pond

Permeable pavement

Multipurpose Retardation Basin

Infiltration pipes

Piloti

Gauging Station

Retardation Pond

Park Storage

Underground drainage/storage

Pumping Stations

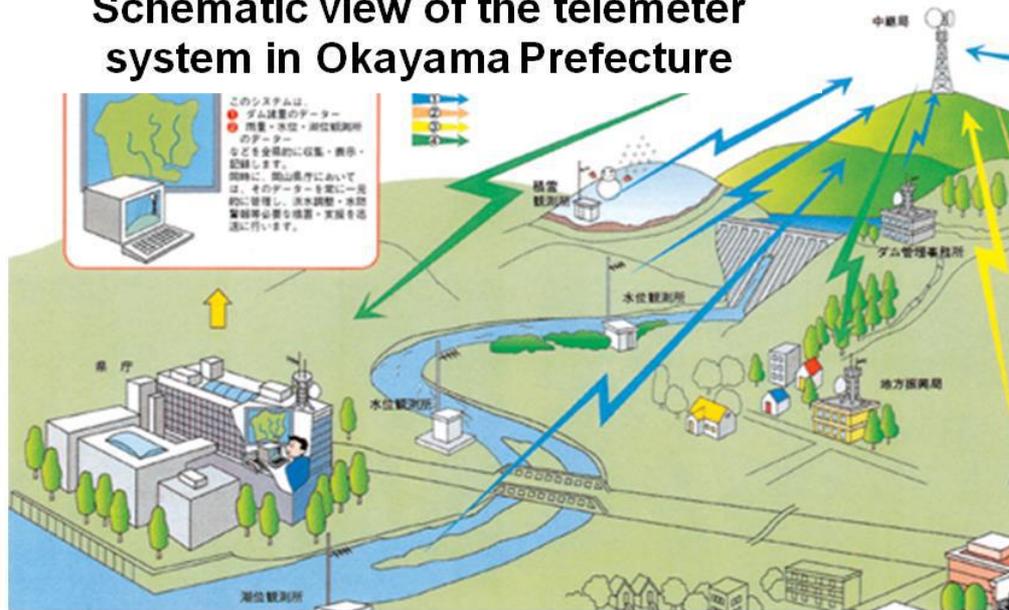
On-River Measures

Storage/Infiltration Measures

Land-use Measures

# Schematic view of the telemeter system in Okayama Prefecture

このシステムは、ダム決壊のデーター、雨量・水位・濁位観測所のデーターなどを自動的に収集・表示・記録します。同時に、岡山県庁において、そのデーターを常に一元的に管理し、洪水警報・水防警報等必要な措置・実施を迅速に行います。



# Flood preparedness drill



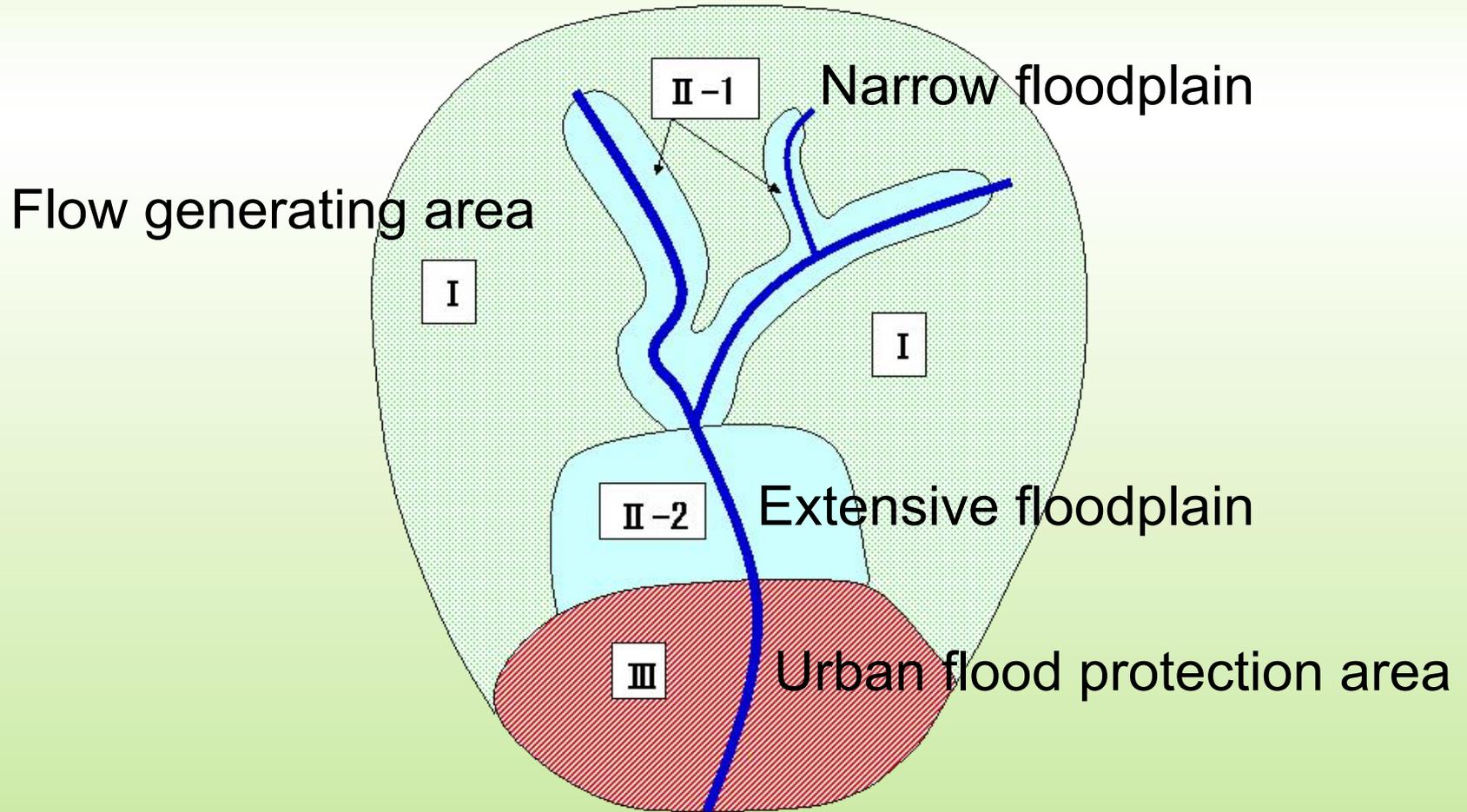


# Effective flood control by including basin resistance

Recommendation by River Council of MLIT

- Extension of the established **comprehensive FC measures** in the rapidly developing basins to any basins.
- **Structural measures alone** cannot enough reduce flood hazards both in rural and urbanized areas.
- **Accepting inundation** in habited land.

## Image of a Basin



	I : 雨水の流出域
	II-1 : 洪水の氾濫域 (非拡散型)
	II-2 : 洪水の氾濫域 (拡散型)
	III : 都市水害の防御域

# Basic concept of “basin resistance”

(“from river to basin”)

- Basin is divided into **flow generating area**, **flood plain** and **urban protection area**.
- **Basin** and **river** should share the roles.
- In addition to continuous levees and dams
  - **Flow generating area**: storage; infiltration; reserv. operation;
  - **Extensive Flooding area**: open dikes; secondary dikes; flood proofing;
  - **Narrow Flooding area**: land elevation; ring dikes; zoning, landuse control;
  - **Urban protection area**: joint operation with sewerage; flood proofing of lifeline & underground; hazard maps; warning and evacuation;



遊水地

水制

霞堤



二線堤

樋門 樋管



排水機場

排水機場



水門



排水機場内部

輪中堤



堰



Open dikes at the Tedori River, Ishikawa Prefecture, designated as a heritage of civil engineering structure by JSCE (2012)

1950

昭和20年代

Secondary  
dikes

2010



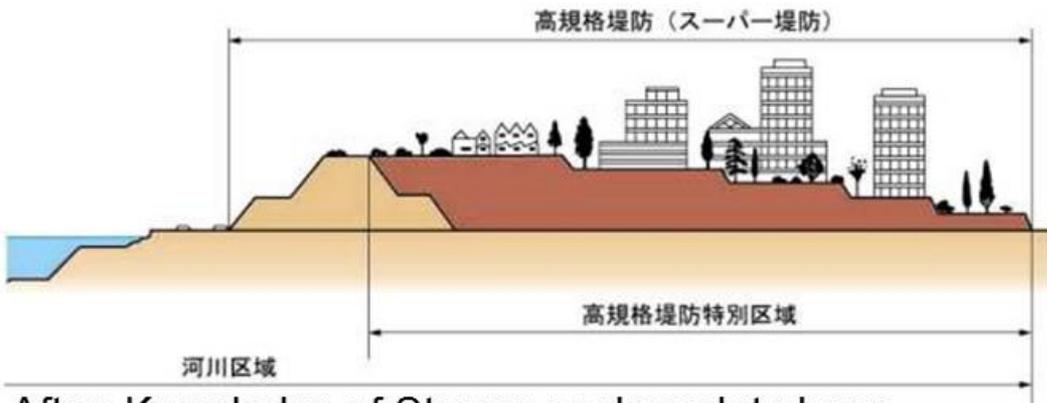
平成22年



市街地を洪水による浸水被害から守るため川中地区下流を置されていました。

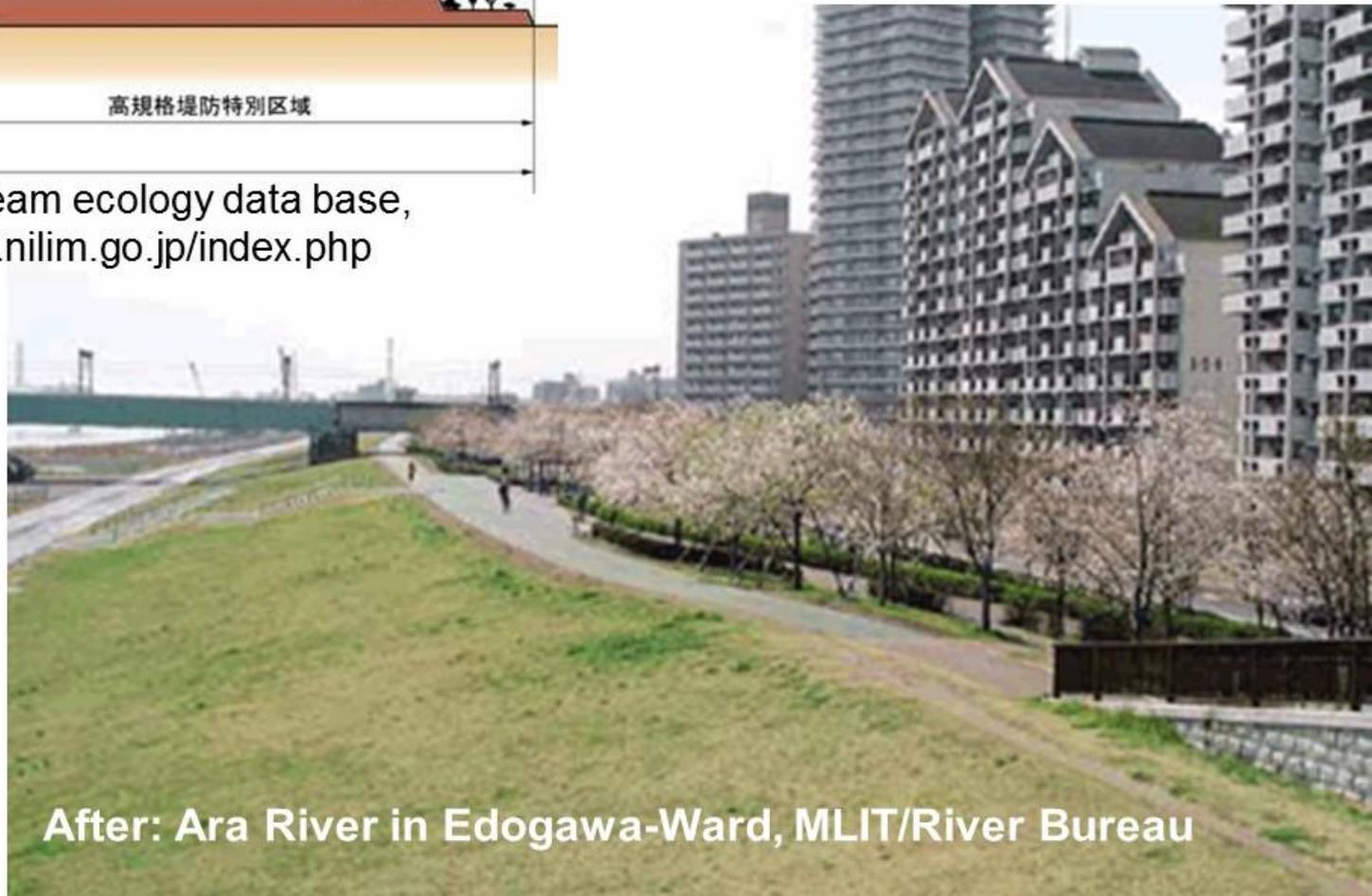
近年では、川中地区上流の開発等により、洪水時の浸水被害を防ぐため五ヶ瀬川右岸、大瀬川左岸にそれぞれ本堤が設置されたため、川中地区を横断する当時の本堤は二線堤となりました。

# Super Levees since 1987



After: Knowledge of Stream ecology data base,  
NILIM <http://kasenseitai.nilim.go.jp/index.php>

Cost recovered  
by the benefit  
of urban  
redevelopment.



After: Ara River in Edogawa-Ward, MLIT/River Bureau



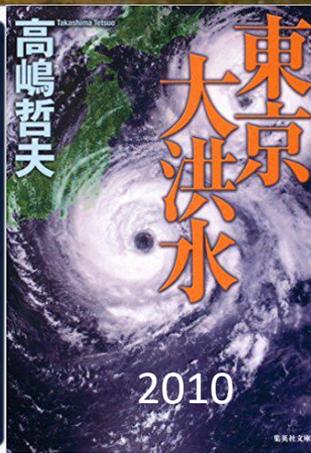
But new types of disasters emerge and damages do not decrease ...



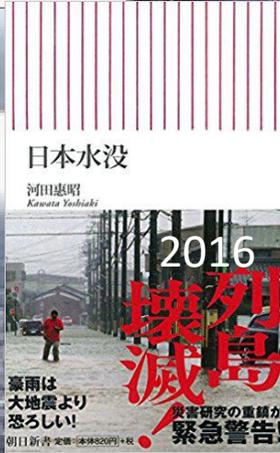
Osaka 2013



Tokyo 2013



Tokyo 2012



Nagoya 2000.9





Water proofing door set above the elevated ground



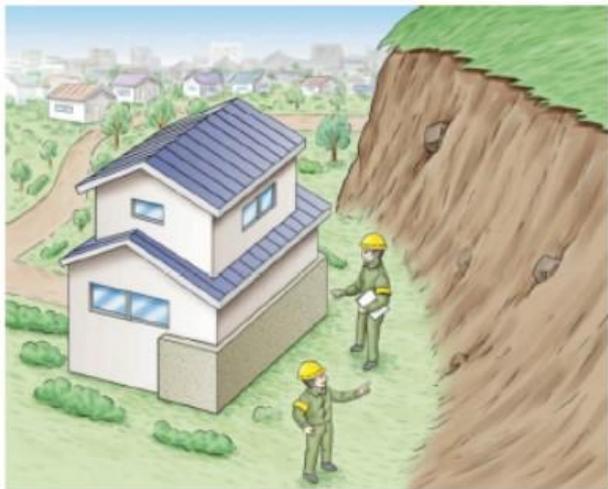
Flood stoppage boards



# Sediment disasters prevention act 2000

Designated danger spots [yellow (red)]: 438 (283)  $10^3$  in 2016

## 建築物の構造規制の概要



Building code

Exposed houses: 529,311 in 2015 (1018 km<sup>2</sup> for all hazards)  
 Disqualified houses: 298,386 in 2001

## 移転事例

Subsidies for relocation



移転前

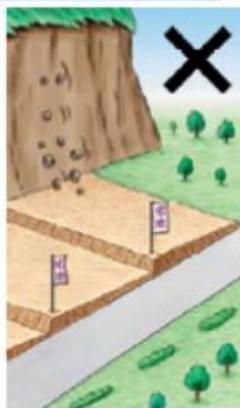
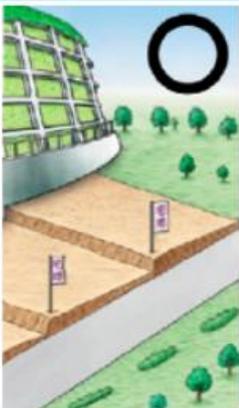


移転後

移転制度を活用して、土砂災害特別警戒区域から移転。

Removal and Interest up to 8.029 M yen/hos (2016)

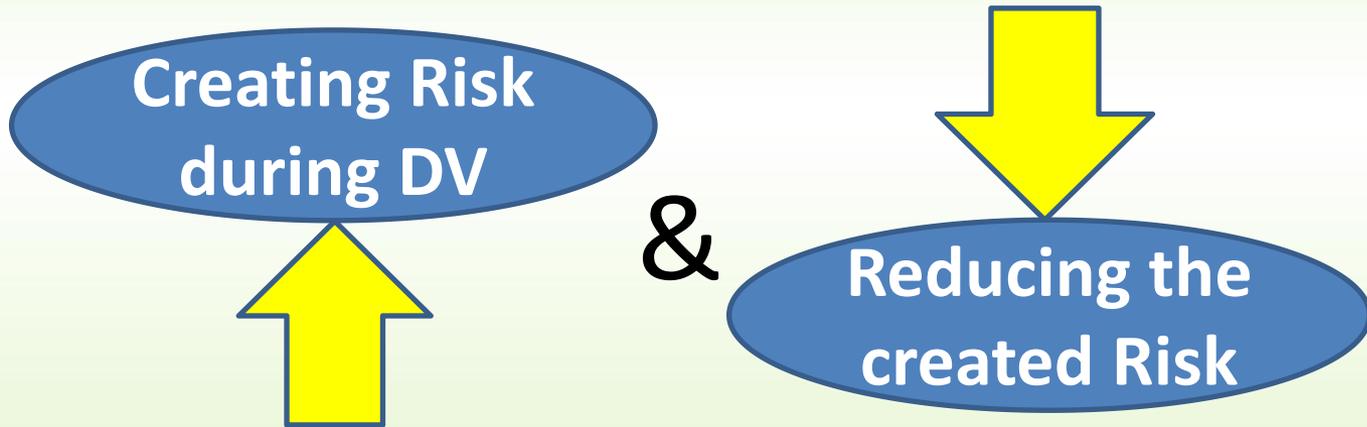
## 特定開発行為の制限の概要



Developmental regulation

土砂災害特別警戒区域内における特定開発行為は、以下の基準に従ったもの限り許可を行う

# Japanese experiences indicate



Replace this scheme by



# How?

- Societal transformation to risk conscious society? Yes!
- Mainstreaming DRR in policy making? Yes!
- Scientific knowledge-based decision making? Yes!
- ***Transdisciplinary approach for scientific knowledge-based decision making!***

# Sendai Framework for Disaster Risk Reduction 2015-2030

3<sup>rd</sup> World Conference on DRR, 18 Mar 2015 (A/CONF.224/CRP.1)

## Priorities for Action

- **Understanding** disaster risk. ➡ Science
- **Strengthening governance** and institutions to manage disaster risk. ➡ Transdisciplinary DM
- **Investing** in economic, social, cultural, and environmental **resilience**.
- Enhancing **preparedness** for effective response, and **building back better** in recovery and reconstruction.

# Transdisciplinary approach for scientific DM to build resilient society



INTERNATIONAL  
COUNCIL  
FOR SCIENCE

futureearth  
research for global sustainability

Co-design  
Co-produce  
Co-deliver  
Co-implement



Multi-hazards WG

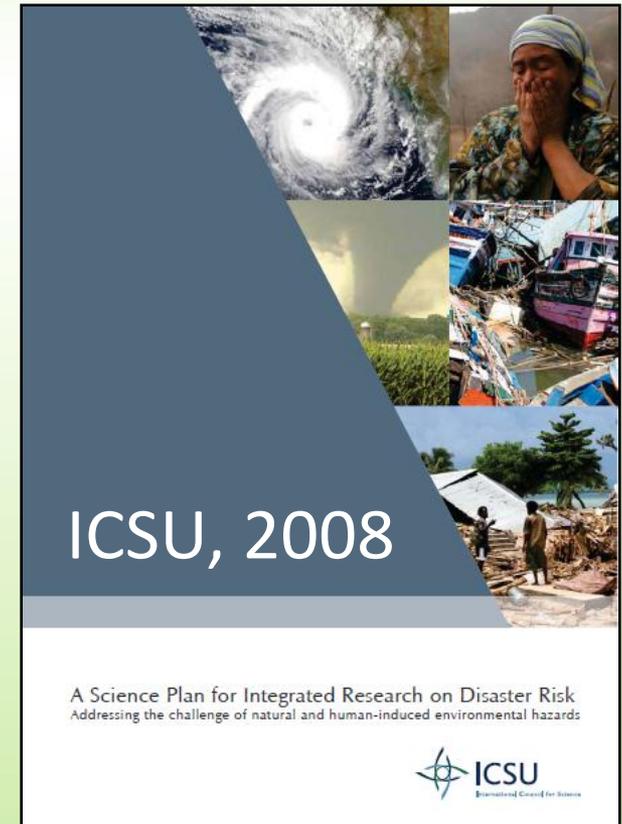


# The Science Plan

**Key science question:**

*Why, despite advances in the natural and social science of hazards and disasters, do losses continue to increase?*

An integrated approach to research on disaster risk through: an international, multidisciplinary (natural, health, engineering and social sciences, including socio-economic analysis) collaborative research programme.



**IRDR Science Plan at:**

[www.icsu.org/Gestion/img/ICSU\\_DOC\\_DOWNLOAD/2121\\_DD\\_FILE\\_Hazard\\_report.pdf](http://www.icsu.org/Gestion/img/ICSU_DOC_DOWNLOAD/2121_DD_FILE_Hazard_report.pdf)

# Knowledge $\rightleftharpoons$ Action Networks (KAN)

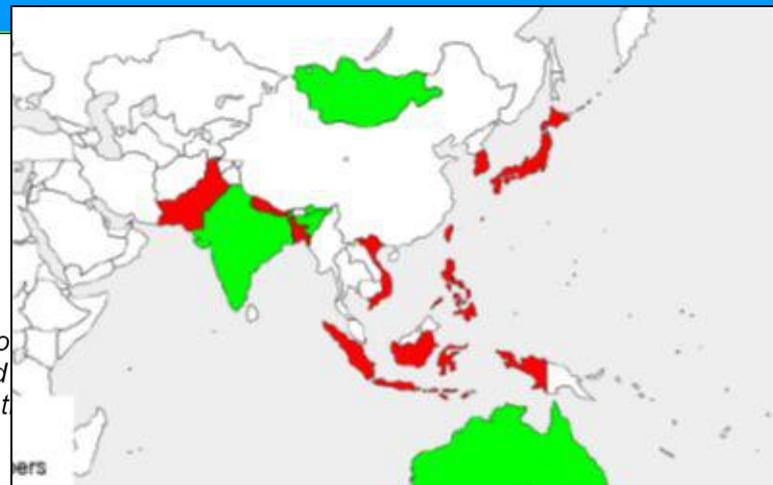
## Framing and Operationalisation

*Version 1.0.1 29 February 2016*

- develop and cultivate **research** that is solution-driven, inter- and **transdisciplinary** i.e. **designed and produced in collaboration with societal partners to bring research closer to society** (i.e., research questions will be co-designed and research co-produced where appropriate).

## ACECC TC21: Transdisciplinary Approach (TDA) for Building Societal Resilience to Disasters

- [HOME](#)
- [TOR & CONCEPT NOTE](#)
- [MEMBERS](#)
- [SYMPOSIUMS](#)
- [LINKS](#)
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The 21st technical committee of [ACECC](#) (Asian Civil Engineering Co (TDA) for Building Societal Resilience to Disasters,” was established ACECC held in Gunsan, Korea, to support states to further develop t decision-making on disaster risk reduction (DRR) through TDA.

[Transdisciplinary Approach \(TDA\) for Building Societal Resilience to Disasters – Efforts towards Achieving the Goals of Sendai Framework –](#), [World Bosai Forum, Monday, November 27, 2017, Sendai, Japan](#)



TC21 session at World Bosai Forum / IDRC 2017 in Sendai, Japan (November 27, 2017)

<http://www.acecc-world.org/TC21/index.htm>

TC21 was established in July 2016 at 7th Civil Engineering Conference in the Asian Region (CECAR)



Co-Chairs Dr. K Takeuchi and Dr. Romeo Momo, Under Secretary of Dept of Public Works & Highway, Philippines.



TC21 Members from Indonesia, Taiwan, and U.S.A.

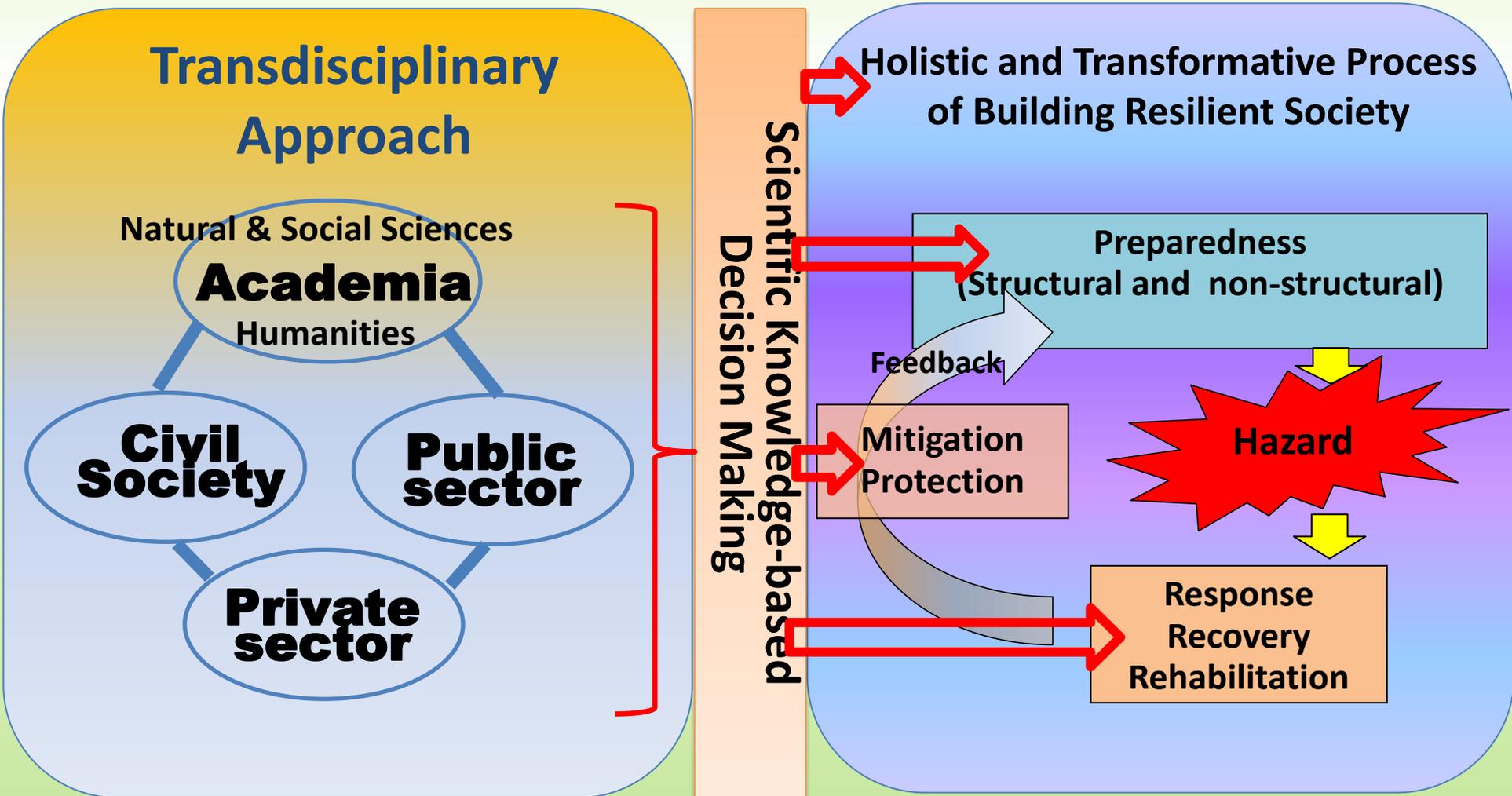
# Objectives

- TC21 aims to *promote* the *transdisciplinary approach* for *scientific knowledge based decision making* for building societal resilience to disasters *at national and local levels*.



Compiling example cases of TDA practices for 2019 ACECC General Assembly in Tokyo

# Transdisciplinary Approach for Scientific-Knowledge Based Decision Making for Building Societal Resilience to Disasters



Co-Design, Co-Produce, Co-Deliver, and Co-Implement



### **Multidisciplinary**

*Good dish needs various materials and ingredients such as meat, vegetables, spices, cook, pans, heater, cook books,*

### **Interdisciplinary**

*Good meal needs good dish, drinks, deserts, table, napkin,*

### **Transdisciplinary**

*Good dinner party needs meals, waiters, partners, music, talks, flowers, interior design,*

**Co-design, co-produce, co-implement,**

# **Trans- disciplinary approach in *DM***

分野部門間協働

(Disciplinary and sectoral  
cooperation)

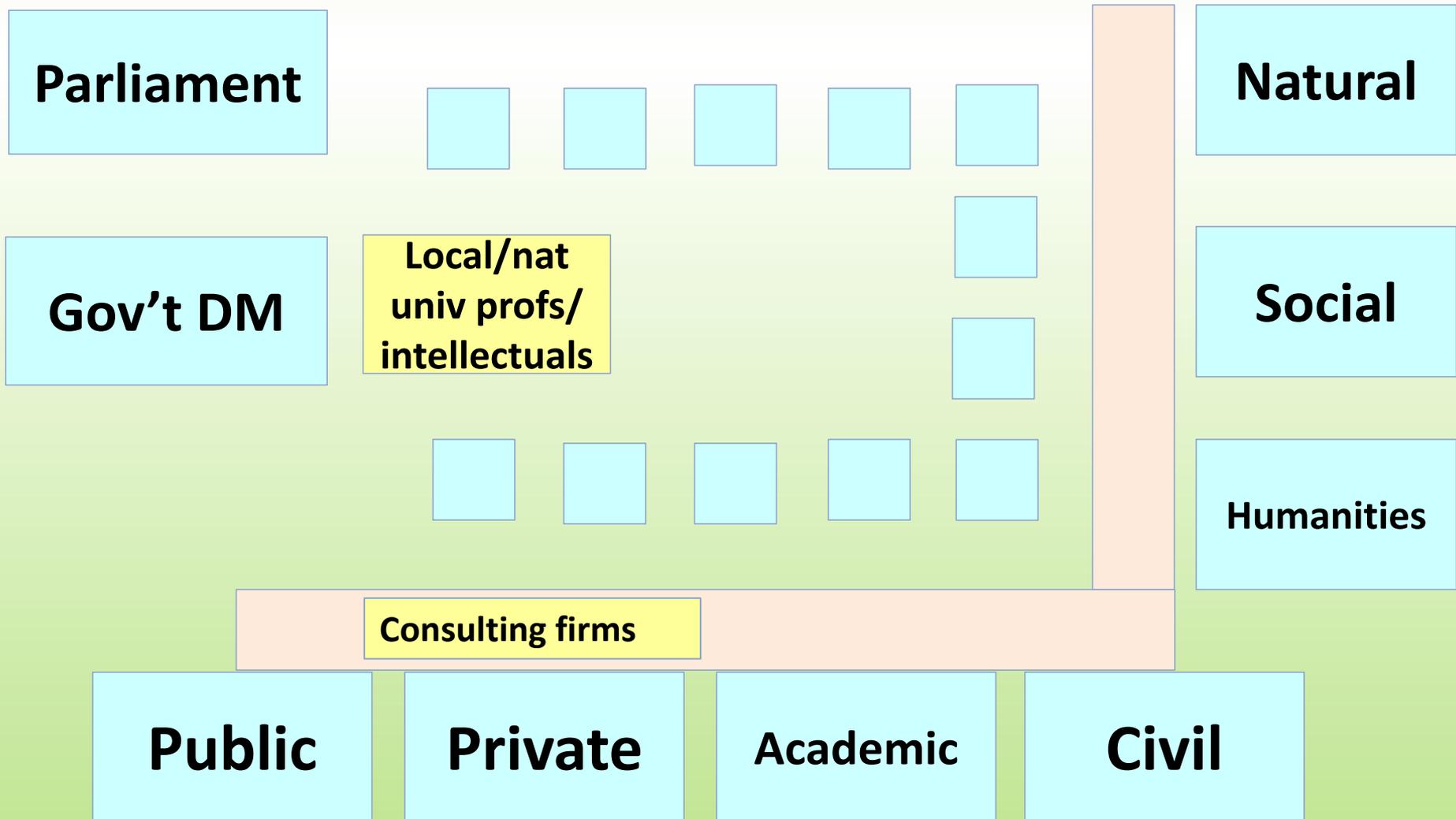
Transparency in  
decision making

Full societal  
support for  
implementation

# Some case studies

- Japan (DM committee)
- Philippines (**Ormoc Flood**)
- Philippines (**Tacloban Storm surge**)
  - Nepal (**Gorkha EQ**)

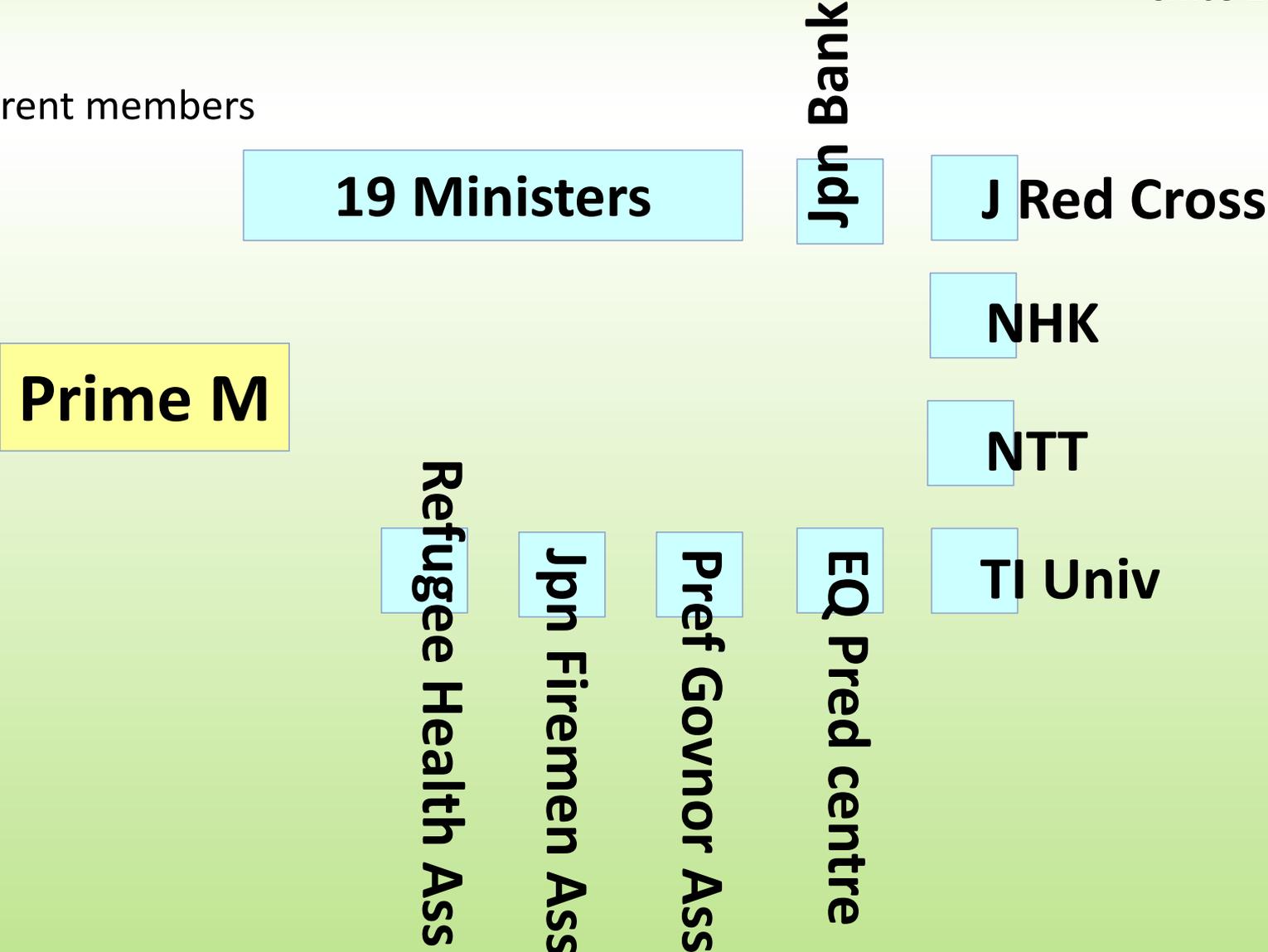
# Typical mechanism for scientific knowledge based DM



# CO Central Disaster Management Council

Since 1961

Current members



# CO Central Disaster Management Council Special Comm on EQ and Tsunami after GEJE

July 2011-

Gov't DM

Niigata Govnor

Kamaishi Mayer

Yaizu Mayer

NHK

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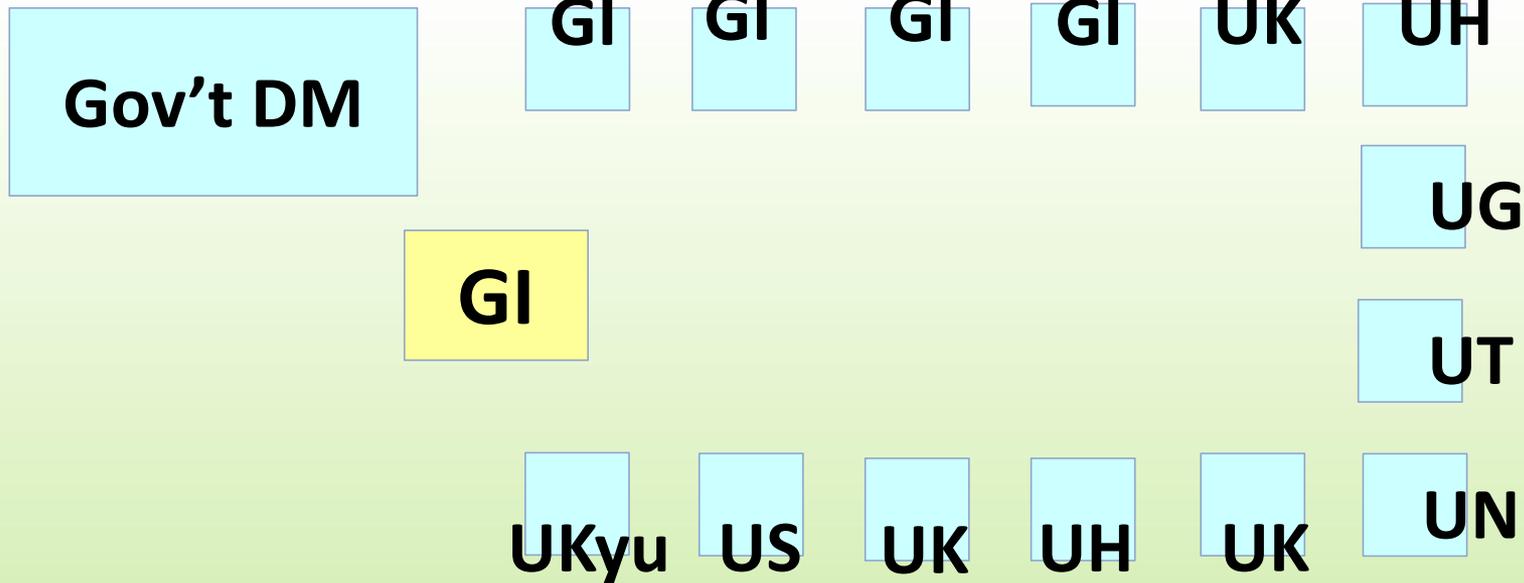
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# MLIT Technical committee on flood control under climate change Apr 2018-

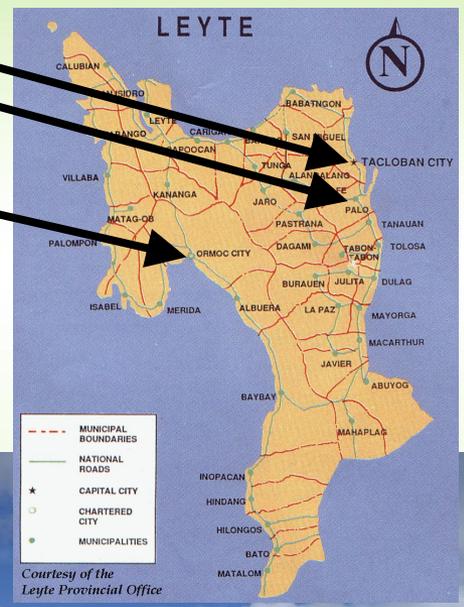


Univ and Research institutes are dominant

# Site Survey in the Philippines, Nov 2016

Ormoc City:  
Establishment of Flood Mitigation Committee covering central and city government, and barangay, the smallest administrative unit in the Philippines. River maintenance works are done by communities.

Tacloban City  
Palo Municipality  
Ormoc City



Slit Dam in Ormoc City, Leyte Island, the Philippines



Resettlement Housings, Tacloban, Leyte Island, the Philippines

# THE ORMOC CITY TRAGEDY

*On 5 Nov 1991, Debris flow hit the urban center of Ormoc and killed about 8000 people*



- Slit dams
- Channel improvements
- Fence to stop squatters

*Maintenance by transdisciplinary approach involving all stake-holders of the community.*



# ILLEGAL STRUC- TURES



Houses above the revetment



Rest house under the bridge



Blocked drainage due to house extension

# River Walk

**Fence** became the solution to the squatters' problem!



Solution to the problem of squatters is an extremely valuable “best practice” in the world. After Irwin Antonio, 2017



Flood Fighting Activity After Irwin Antonio, 2017

# Typhoon Haiyan tsunami-like storm surges on 8 Nov 2013

Killed 6,300

Damaged houses 1.1 million

Evacuation refugees 4.1 million



Tacloban, Leyte Oct 20, 2015

40  
NOV-2011  
MIZON DL - LB ON M





40m no build zone -> rapid recovery  
Replacement of about 14,600  
houses in the northern Tacloban.

*Intensive consensus building  
process involving 138 barangay  
chiefs*



# Site Survey in Nepal, April 2017



Source: BBC News



Source: <http://www.ifrc.org/en/news-and-media/news-stories/asia-pacific/nepal/in-pictures---nepal-earthquake/>

# The Gorkha earthquake, Nepal

## 11:56 NST April 25, 2015

- Killed nearly 9,000 people
- Injured nearly 22,000
- 7.8Mw and max Mercalli Intensity IX (Violent)
- \$10Billion (50% of Nepal GNP)



Dept. of Urban Development & Building  
Construction (DUDBC)

National Reconstruction Authority (NRA)

A sill and lintel band method

300k Rupee Grants Subsidy

With agreement	50k,
print	150k,
roof (band)	100k

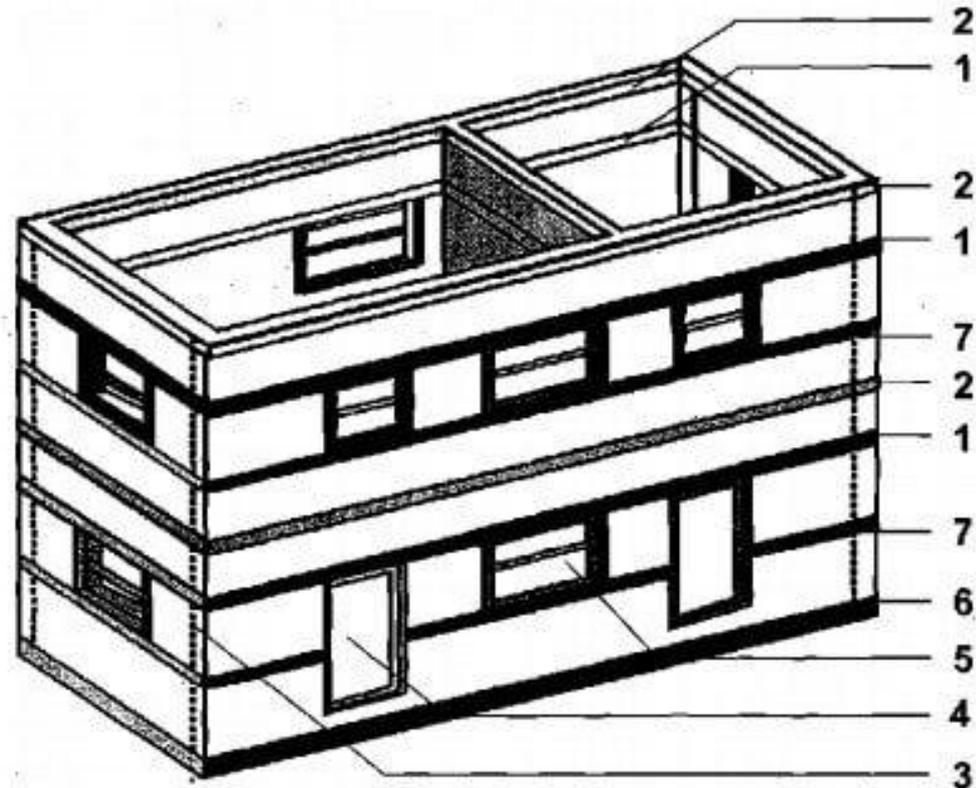
Training of 306 inspection  
engineers

Participation and support of  
local communities

<https://theconstructor.org/construction/horizontal-bands-masonry-buildings-types-location-design-applications/14462/>

## A Sill and Lintel Band Method in a Masonry Building

**1- Lintel Band,  
2-Roof Band,  
3-Vertical Reinforcing Band,  
4-Door,  
5-Window,  
6-Plinth Band,  
7-Window Still Band**

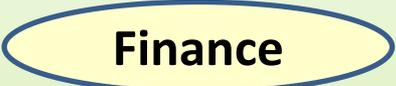




Reconstruction by *transdisciplinary approach*,  
*the public, private, academia and communities*  
*working together.*



# Nepal's reconstruction is a good example of *transdisciplinary approach*

- Dept. of Urban Development and Building Construction (DUDBC) 
- National Reconstruction Authority (NRA)
- A sill and lintel band method 
- 300k Rupee Grants Subsidy 
- With agreement 50k, plinth 150k, roof (band) 100k & final (50k?) 
- Training of 306 inspection engineers 
- Participation and support of local communities

# Preliminary findings

- *Scientists involvement* in DM is little.
- *Scientists* do not necessarily know how to use their knowledge.
- *Scientific knowledge* for complex problems is little.
- *Assessment and selection process* for alternative courses of action is unclear.
- TDA can solve the problem of DM proc. but so far:
  - TDA exercises are top-down by responsible agencies.
  - TDA are limited in *high level DM*,
  - but often well practiced in *implementation stage*.

# Final remarks

- Is IWHR prepared for new type floods and other water-related disasters?
  - Urban expansion, underground city, aged society, IT society and supporting infra,
- Is IWHR ready for transparent DM process working with all stakeholders including academia, private sector and civil society.

Let us hydrologists proactively seek for partnership with all others to work together!



# Toward CECAR8

CECAR8 “Resilient Infrastructures in Seamless Asia ”



TC21 are planning to hold international session and submit technical report about TDA



居安思危 Be aware of risk while we are safe  
思則有備 Awareness leads us preparedness  
有備無患 Preparedness leaves us no regret

「春秋」左氏伝

Source: Zuo Qiuming "Zuoshi Commentary"  
in Confucius ed. "Spring and Autumn", 480BC

**Transdisciplinary approach for building  
societal resilience!**

*preparedness for floods*