World Vision Forum, IWHR, 14 June 2018

Water-related Disaster Management in Japan and Transdisciplinary Approach

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Kofu, Japan

UNIVERSITY OF YAMANASHI

山梨大学
UNIVERSITY OF YAMANASHI

Since 1949 (1795)

Core of the Region and Human Resources for the Globe

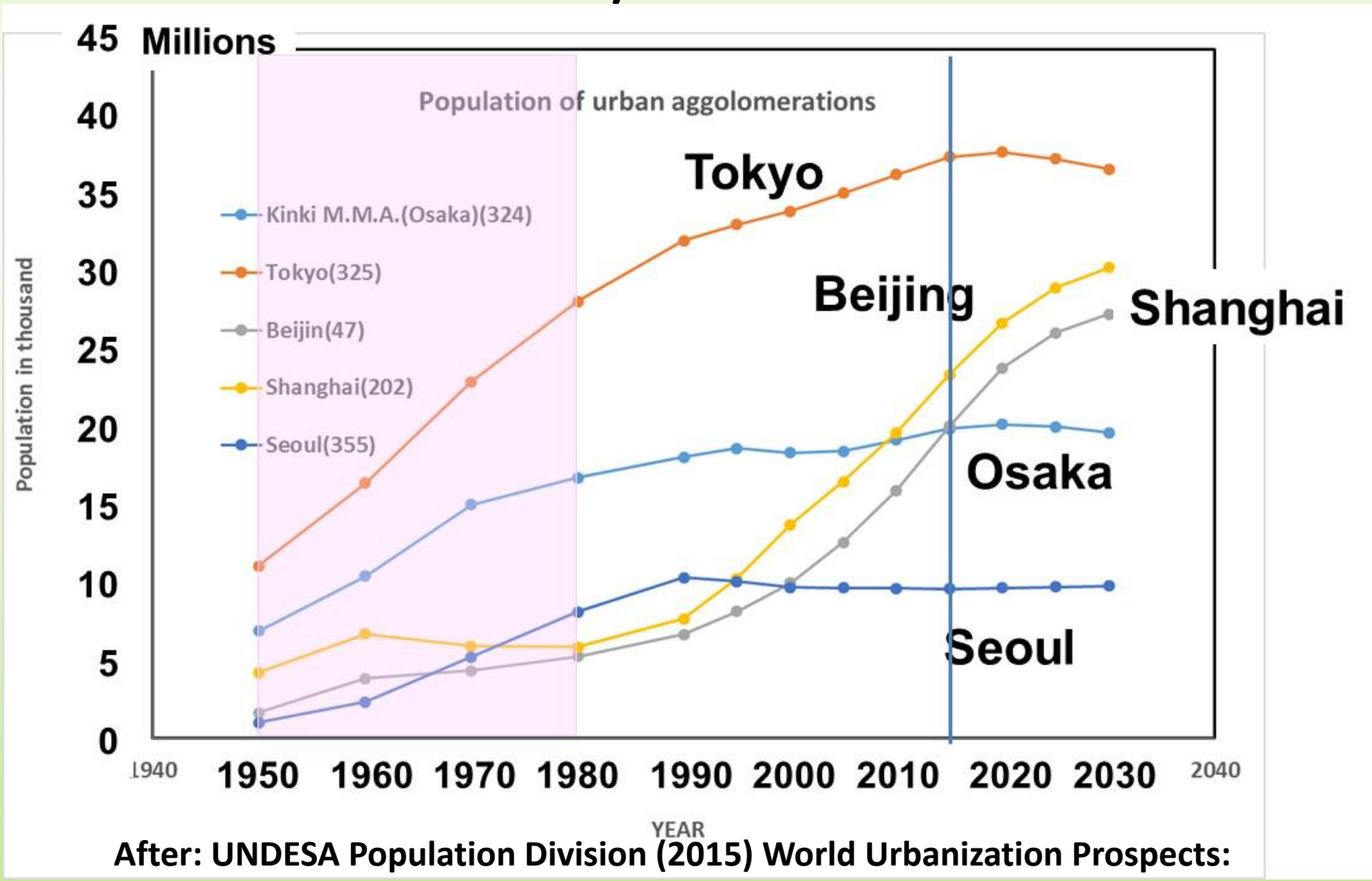
Education, Engineering, Medicine, Life and Environmental Sciences

ICRE
UNIVERSITY OF YAMANASHI

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

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

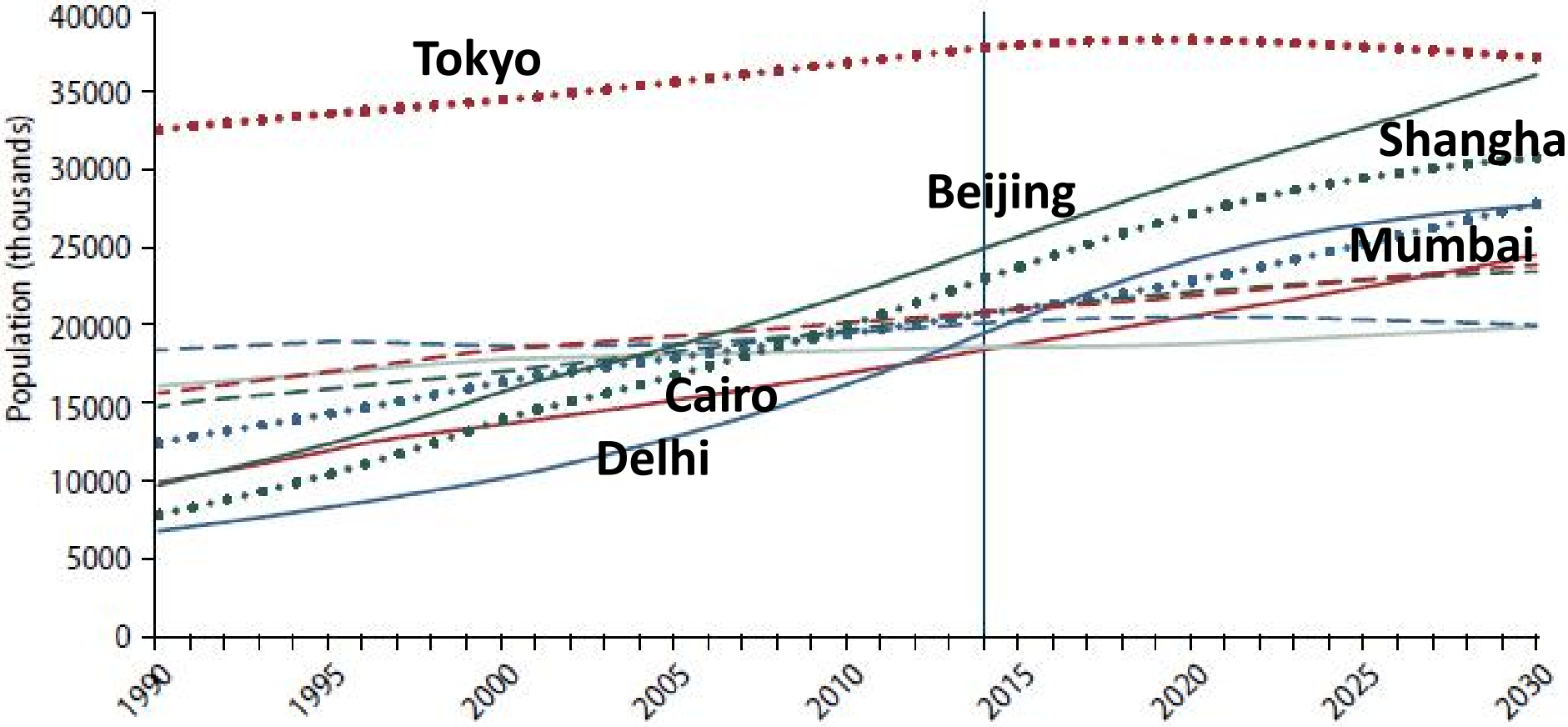
Very rapid urbanization/industrialization



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

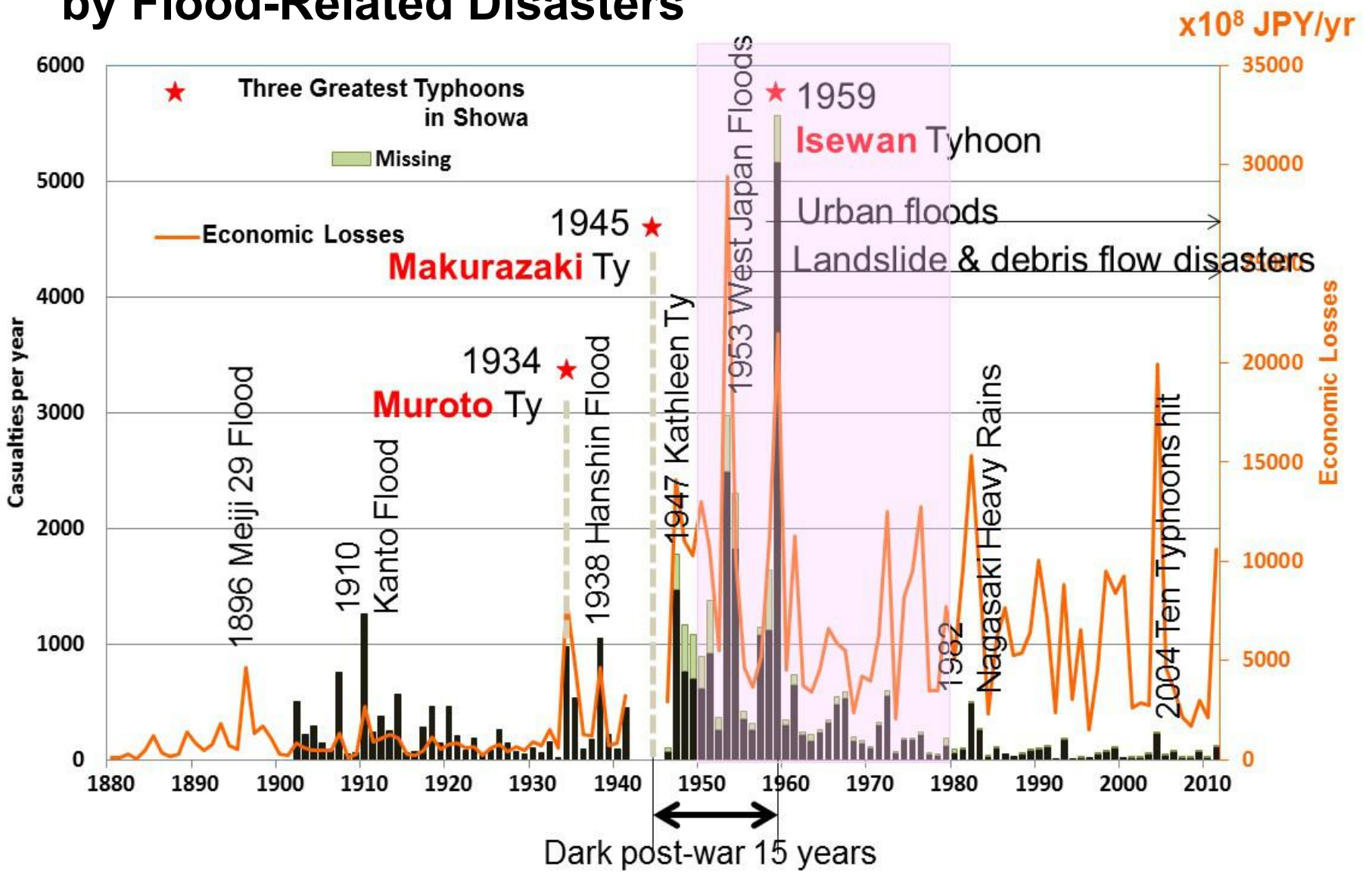
Figure 9.

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



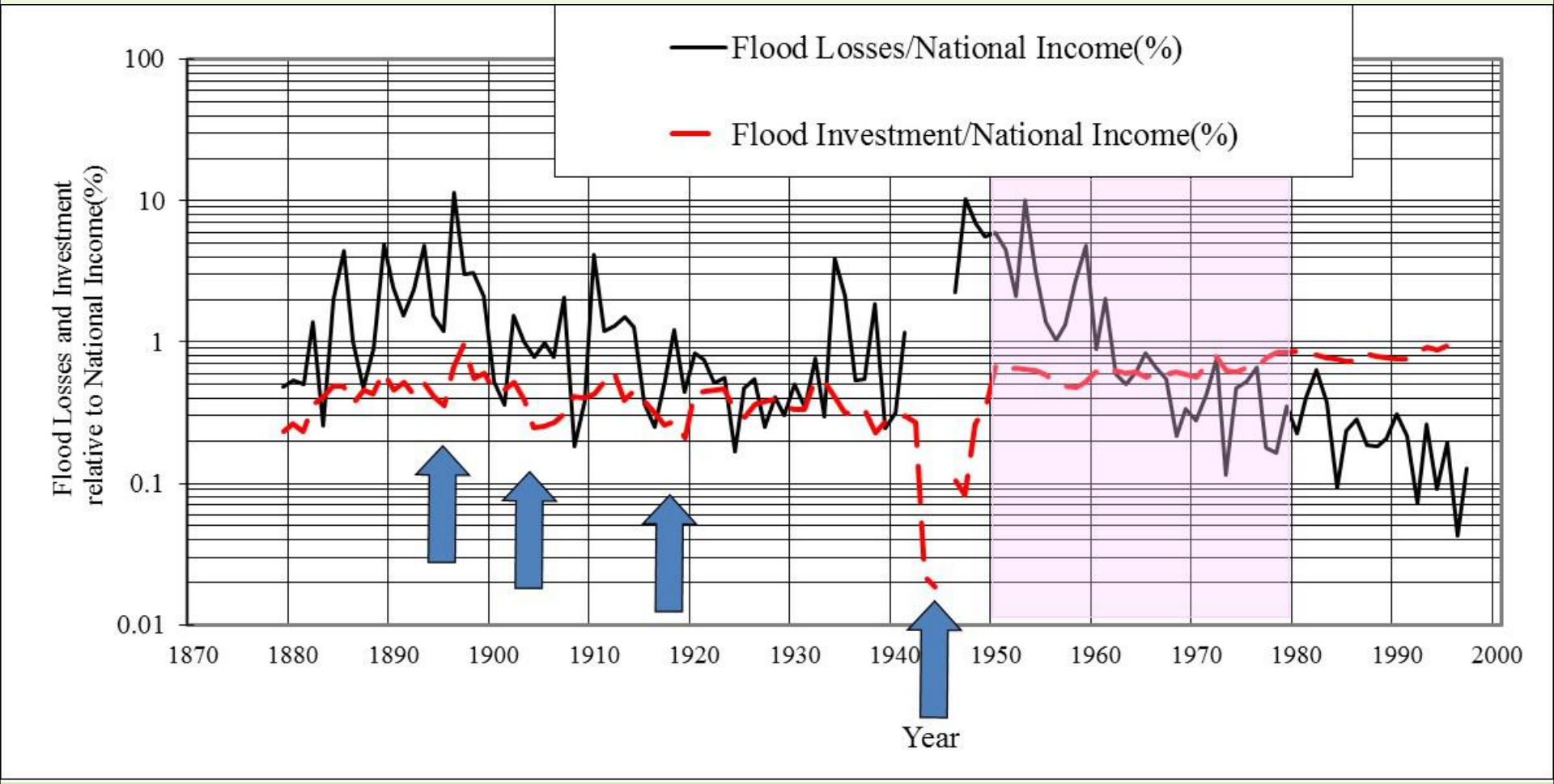
After: UNDESA Population Division (2015) World Urbanization Prospects: The 2014 Revision, ST/ESA/SER.A/366

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



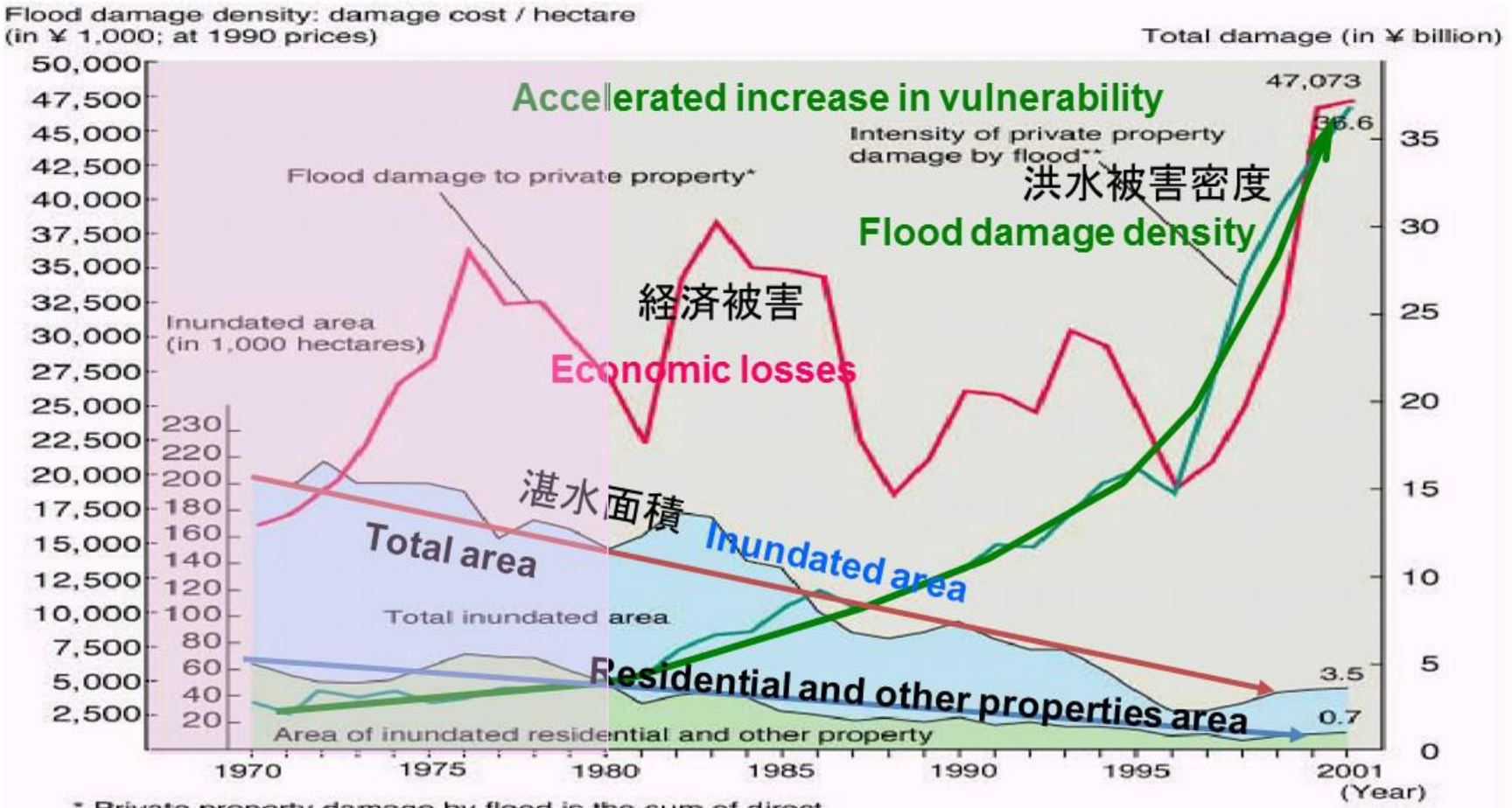
Data Source: MLIT Water Disaster Statistics, 2013

Flood losses and investments



MLIT, Water disaster statistics

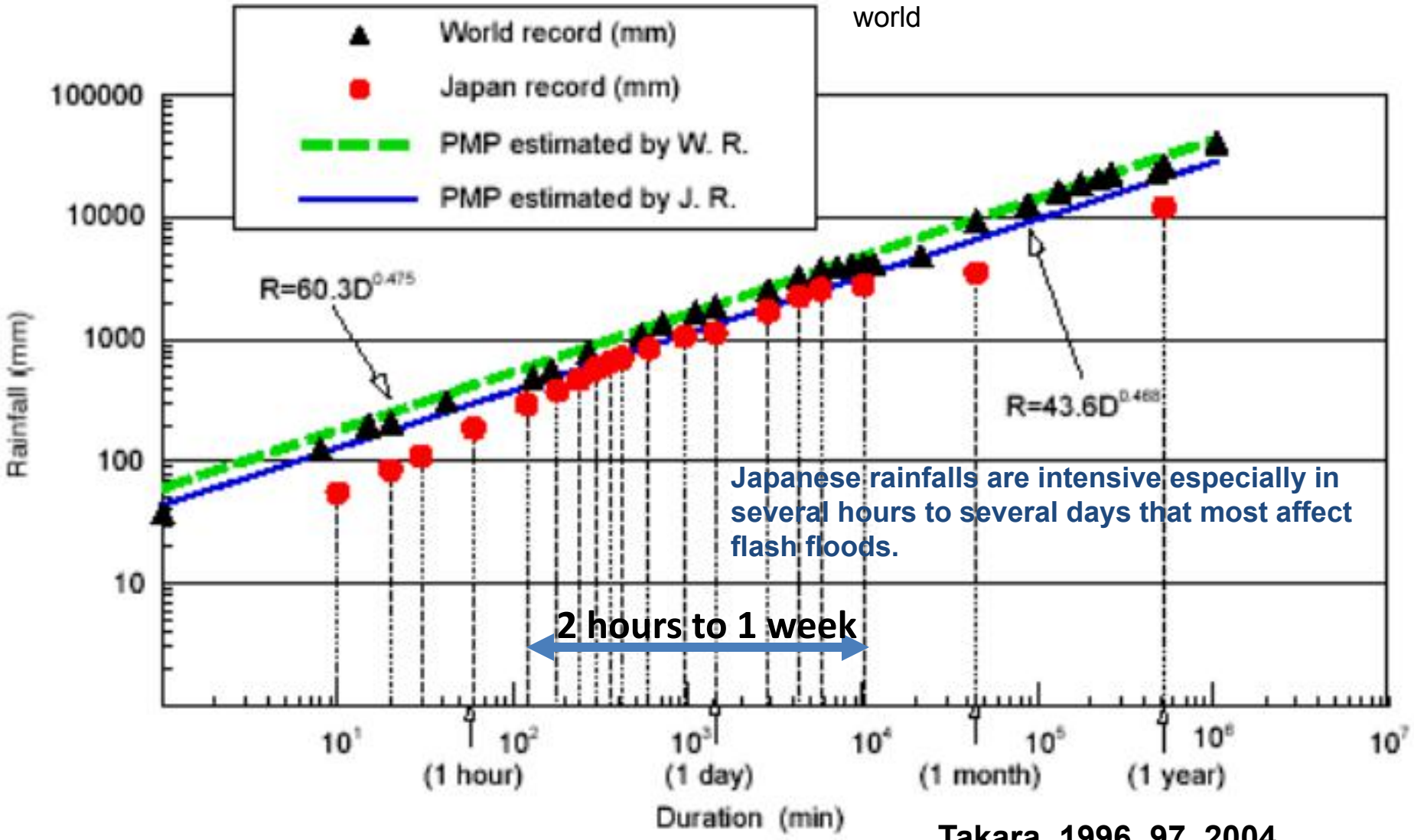
Increase of flood damage potential



The Kano River at Numazu, MLIT

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

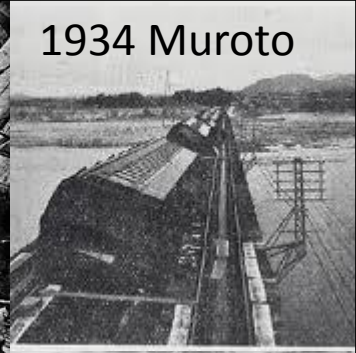
Maximum Precipitation records of the world



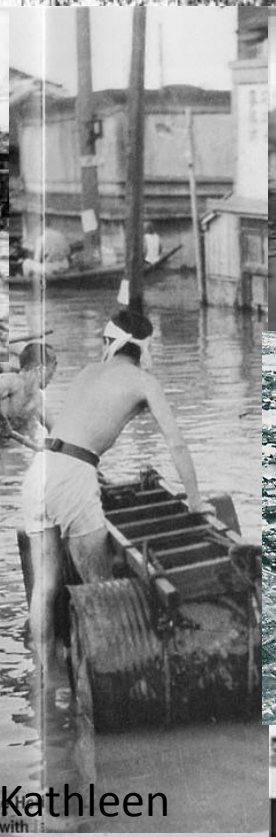
Takara, 1996, 97, 2004

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]

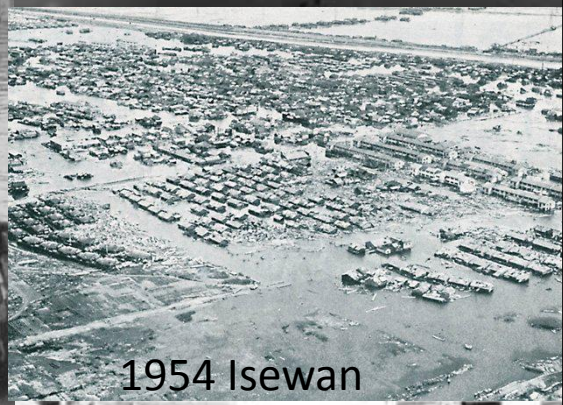
1934 Muroto



1938 Hanshin



1945 Makurazaki



1954 Isewan

1947 Kathleen

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

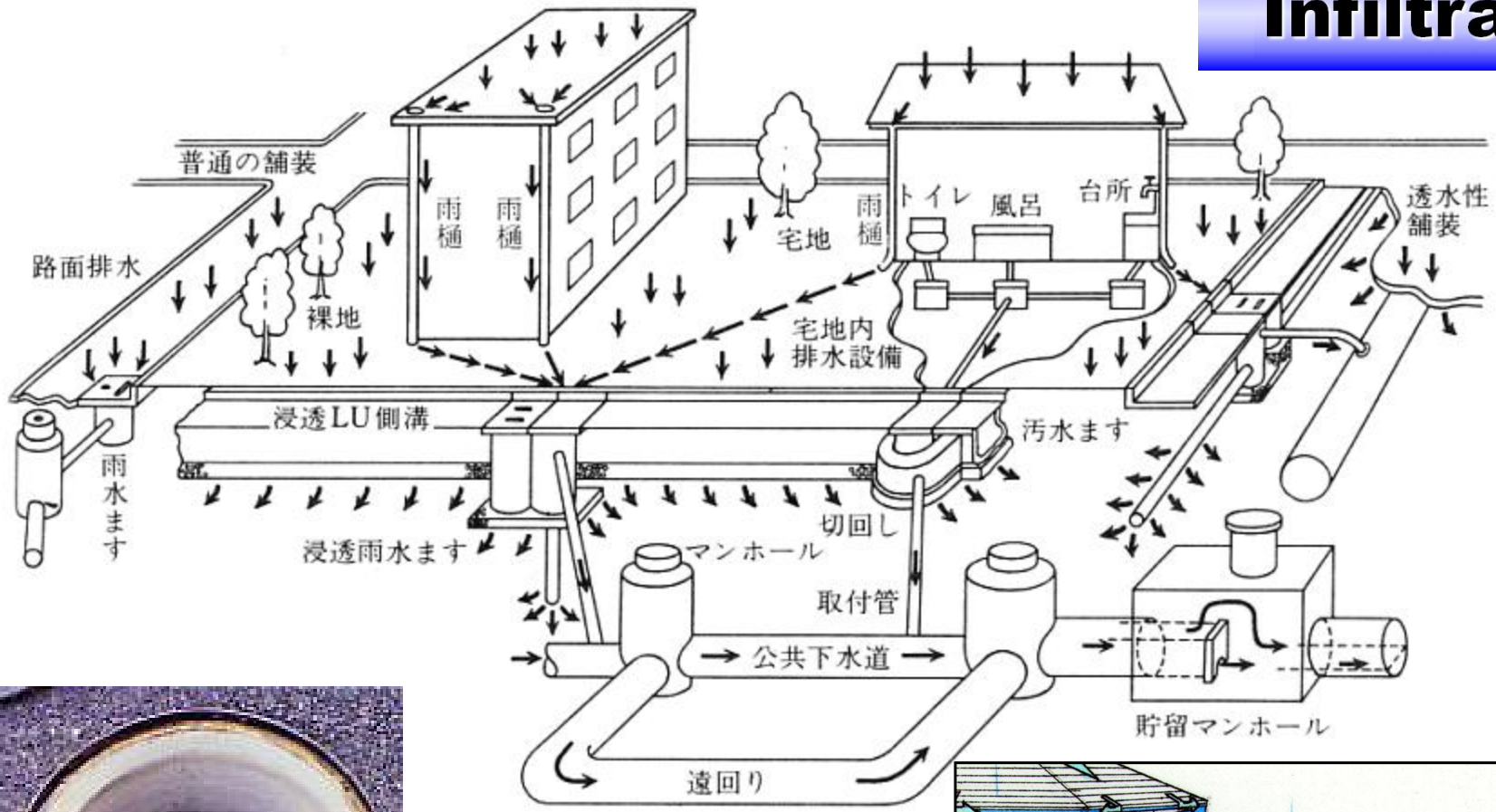
Comprehensive FC Measures

Recommendation by River Council of MOC

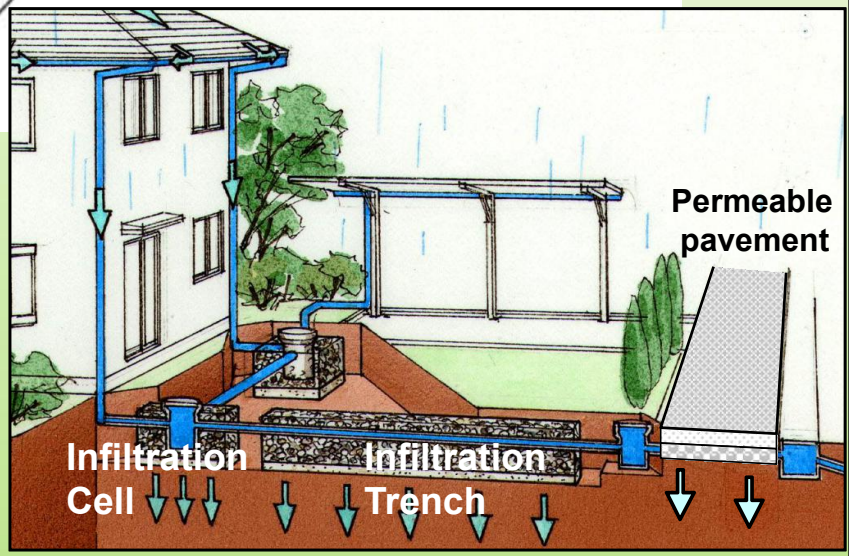
- In rapidly developing basins, in addition to ***traditional*** flood control measures,
- Make land development add no increase of rainfall discharge by promoting ***infiltration & storage***.
- Radar rainfall measurements & information dissemination: FRICS (Federation of river integrated communication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

Sponge City

Infiltration



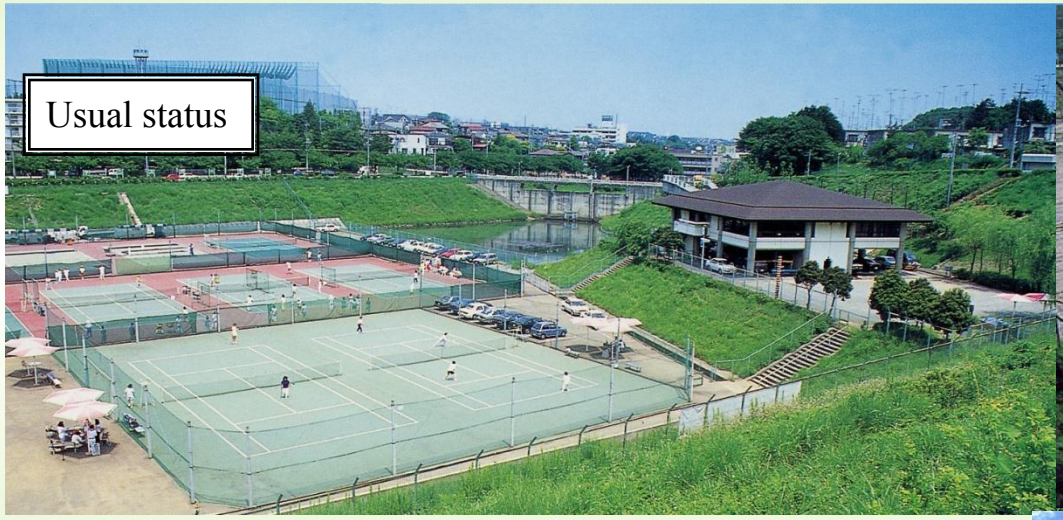
Infiltration Cell



Flood retardation ponds

Slide by Kehin Koji, MLIT

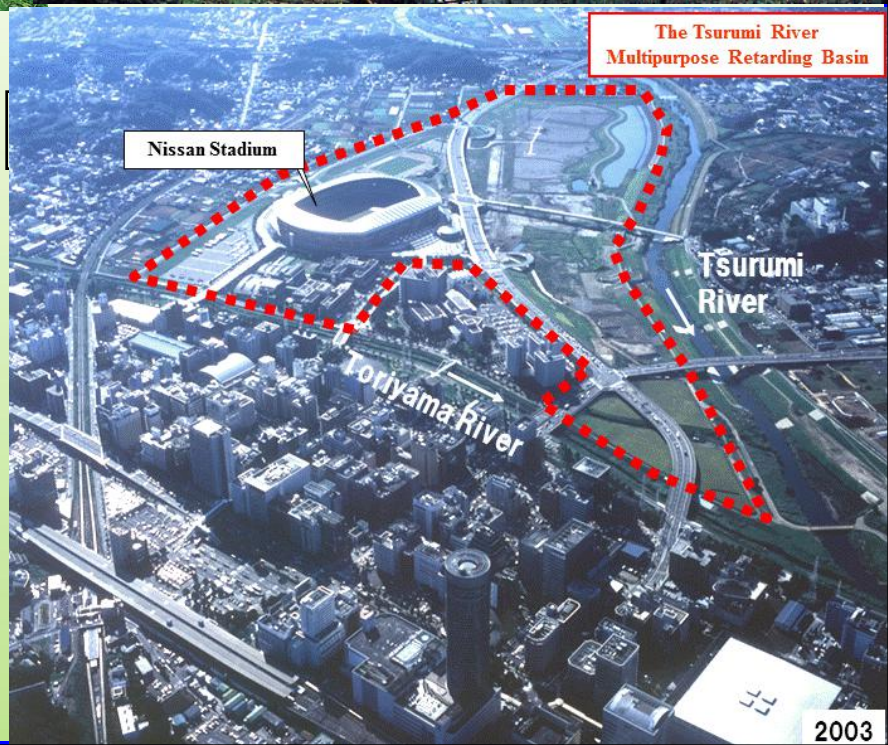
Storage Measures



Kirigaoka retardation Pond (Yokohama City)

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

▼Storage at School Playground

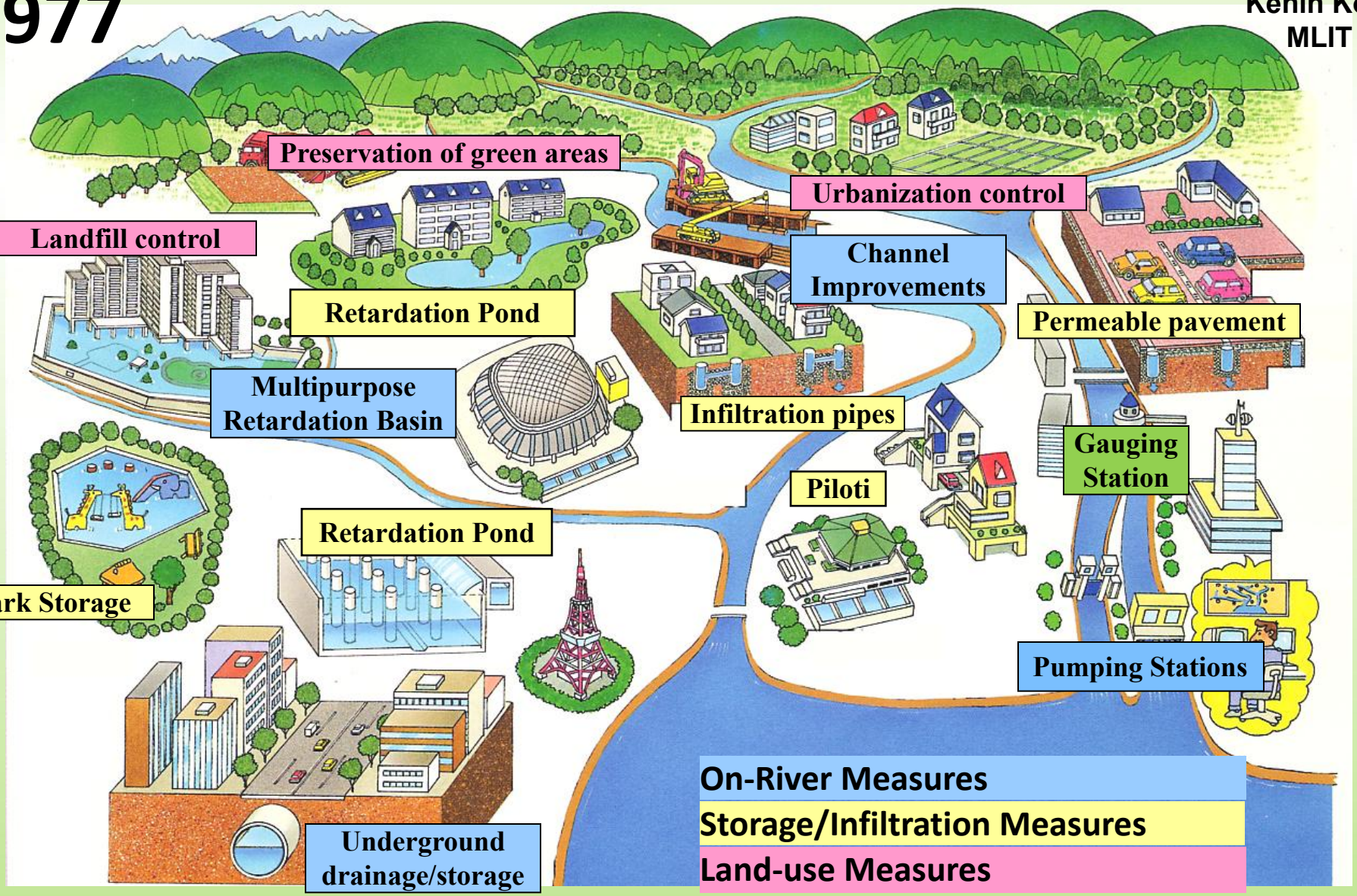


Confluence of Tsurumi & Toriyama Rivers

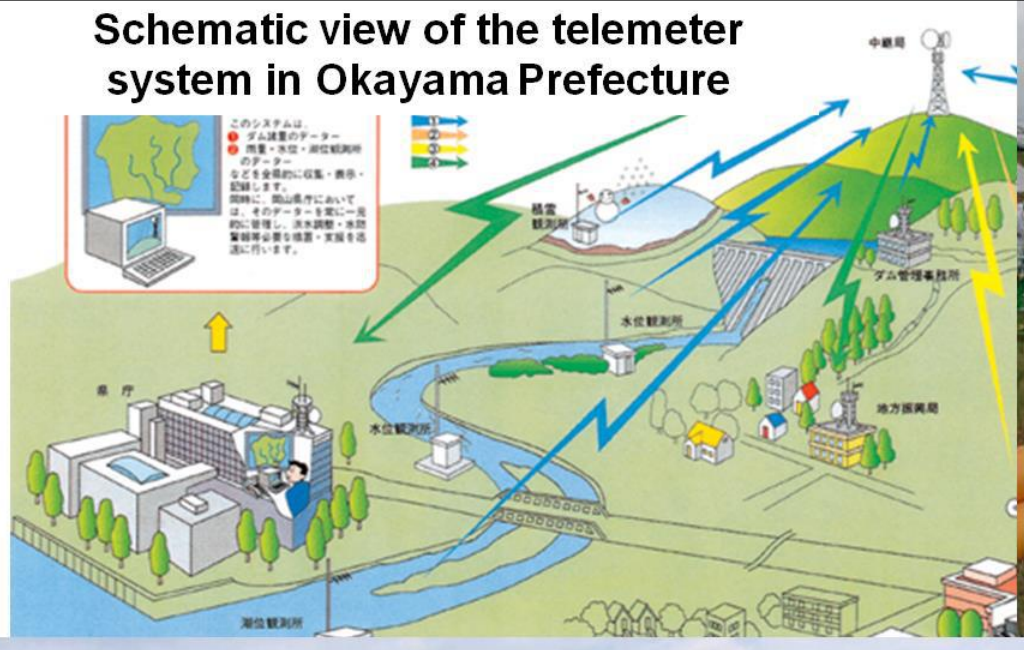
Comprehensive Flood Control Measures

1977

Slide by Kehin Koji, MLIT



Schematic view of the telemeter system in Okayama Prefecture



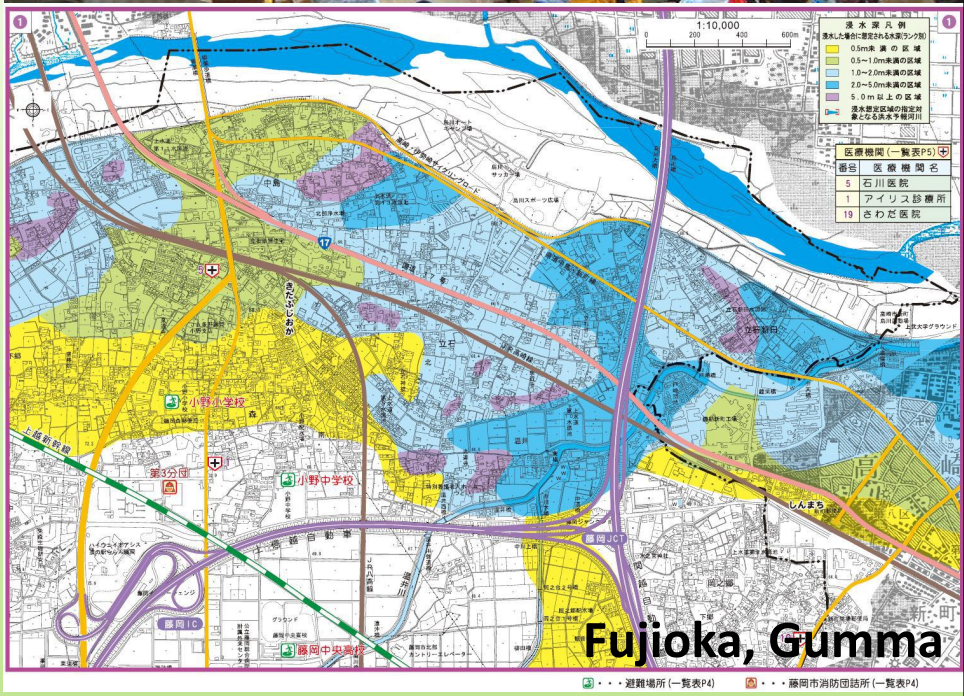
Flood preparedness drill

From Prevention to Preparedness, Response and Recovery

- Self Help
- Mutual Help
- Public Help

- Early warning
(alert→suggestion→order)
- Evacuation
Evacuation drill
- Recovery

Katsushika-ward, Tokyo



Fujioka, Gumma

2000.12

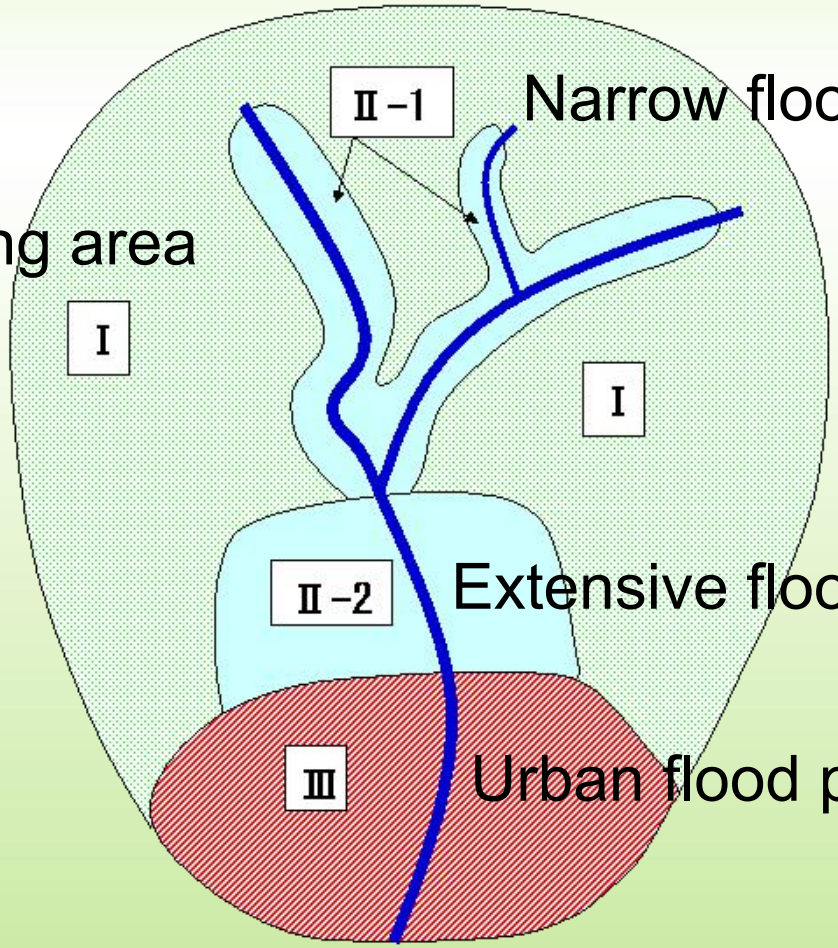
Effective flood control by including basin resistance

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

Flow generating area



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;

http://www.mlit.go.jp/river/pamphlet_jirei/kasen/jiten/yougo/05_06.htm

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

1950

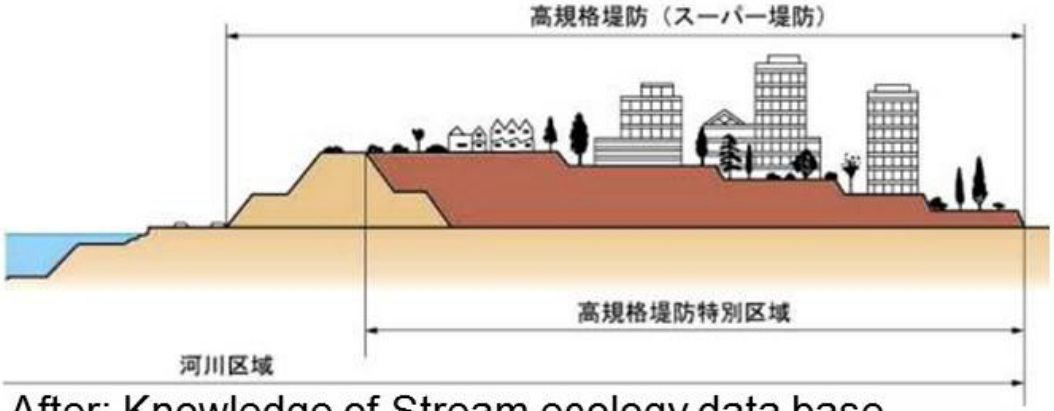
Secondary dikes

2010

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。

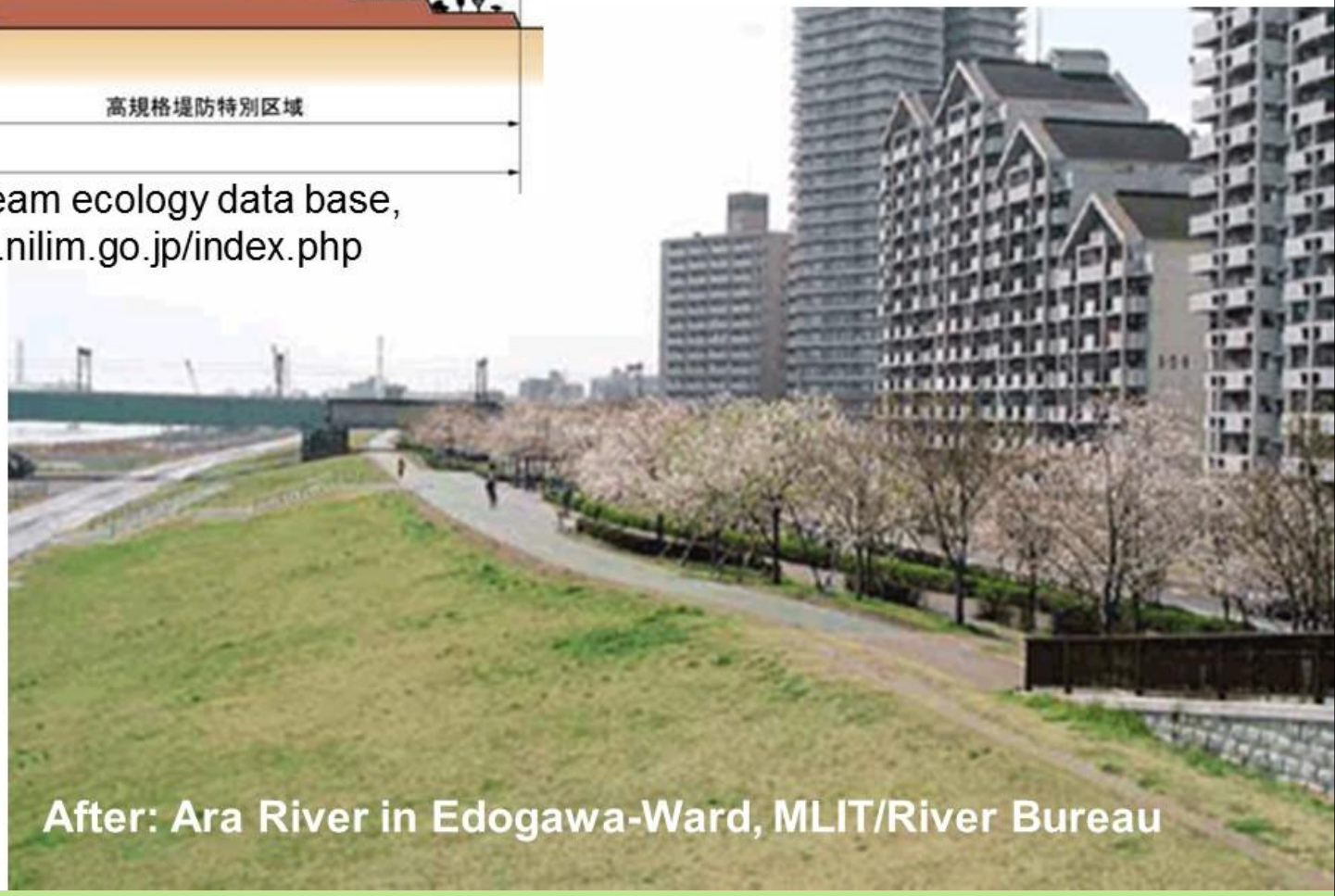
市街地を洪水による浸水被害から守るため川中地区下流を
置されていました。

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

しゅとけんがいかくほうすいろ

首都圏外郭放水路

The Metropolitan Area
Outer Underground Discharge Channel

Completed in 2006

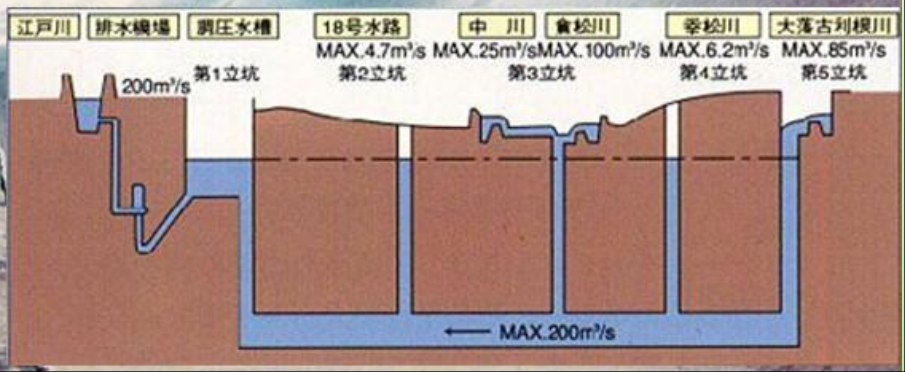
Connecting bet Naka and Edo Rivers

Diameter	10.0 m
Length	6.3 km
Slope	1/1,500
Depth	about 50 m
Capacity	200 m3/s
Storage cap	670,000 m3

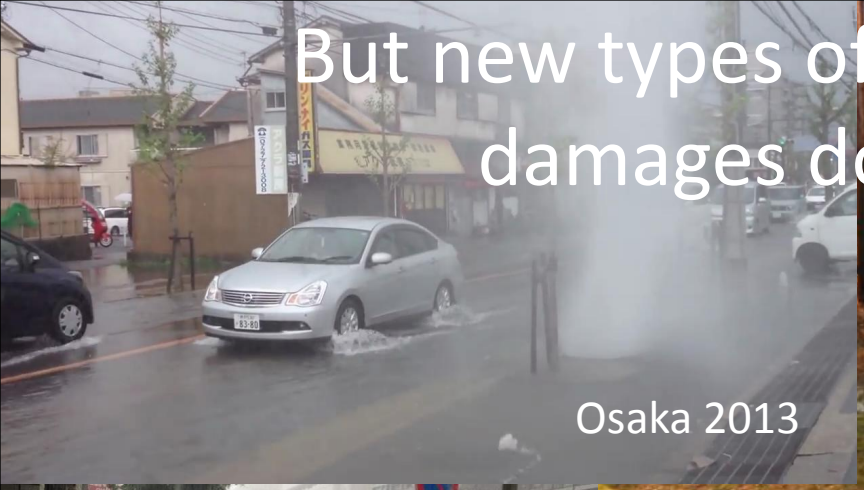
In Osaka Neya River

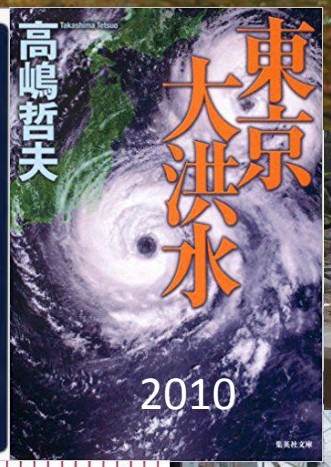
South 11.2 km in 2011

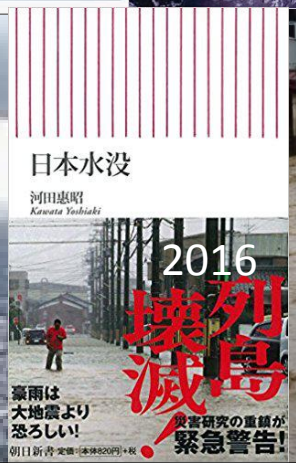
North 9.1 (+4.6) km in 2015



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








Nagoya 2000.9

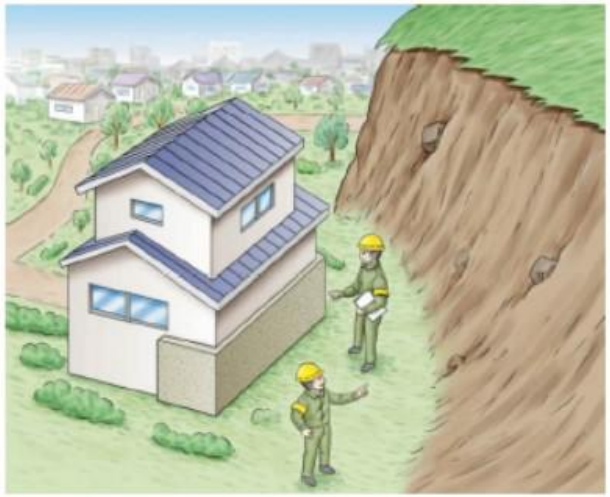
Water proofing door set above the elevated ground

Flood stoppage boards

Sediment disasters prevention act 2000

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

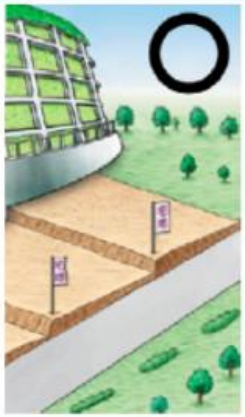
建築物の構造規制の概要

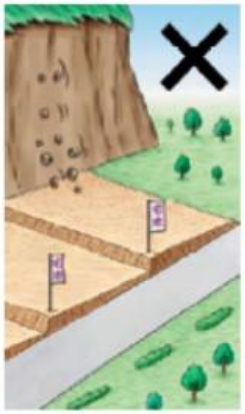


Building code

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

特定開発行為の制限の概要





Developmental regulation

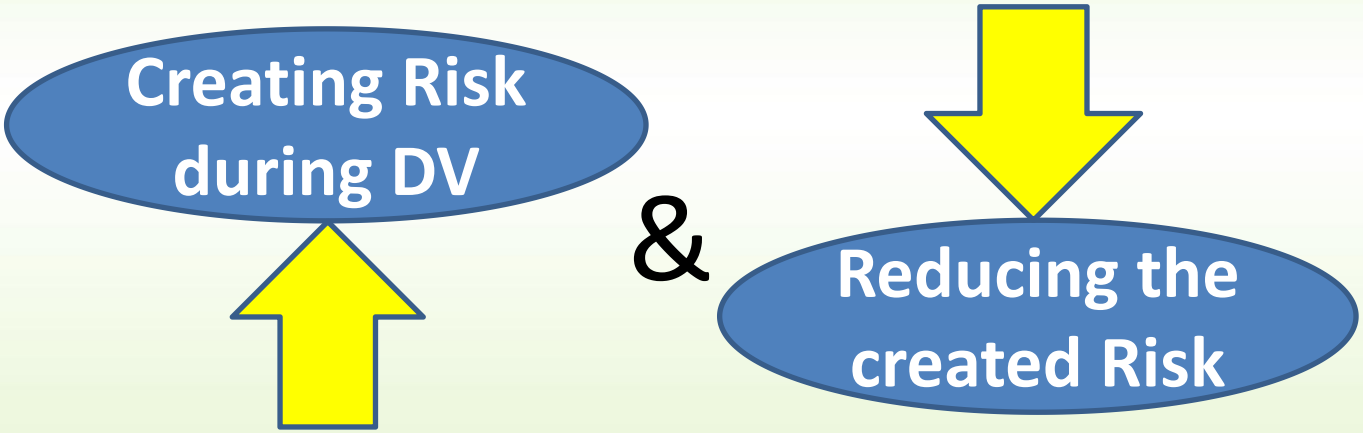
土砂災害特別警戒区域内における特定開発行為は、以下の基準に従ったものに限り許可を行う

移転事例 Subsidies for relocation

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)

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

3rd 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

IRDR
Integrated Research on Disaster Risk

futureearth
research for global sustainability

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

APRU
Association of Pacific Rim Universities

Multi-hazards WG

TC21

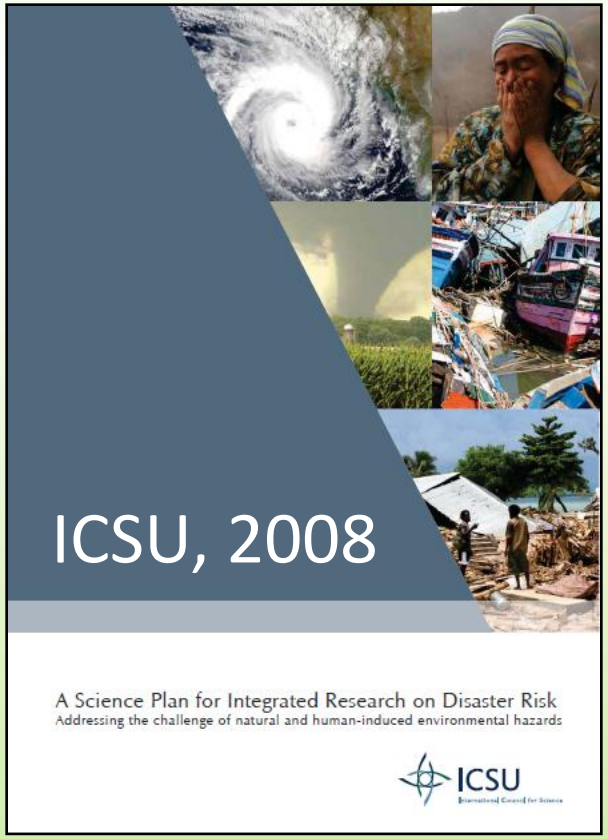
Transdisciplinary Approach (TDA)
for Building Societal Resilience to Disasters

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

Knowledge ⇄ 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).

Asian Civil Engineering Coordinating Council

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

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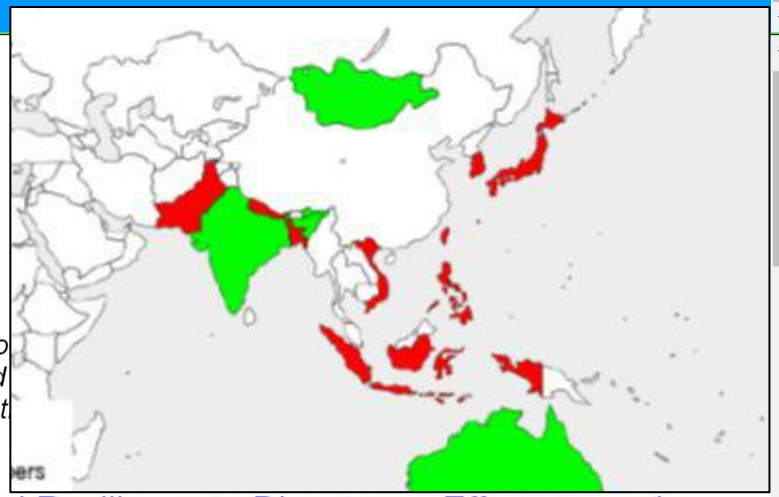
For a Better Quality of Life

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



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

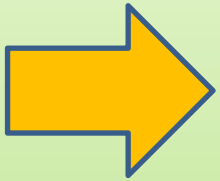
TC21 was established in July 2016 at 7th Civil Engineering Conference in the Asian Region (CECAR)

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.

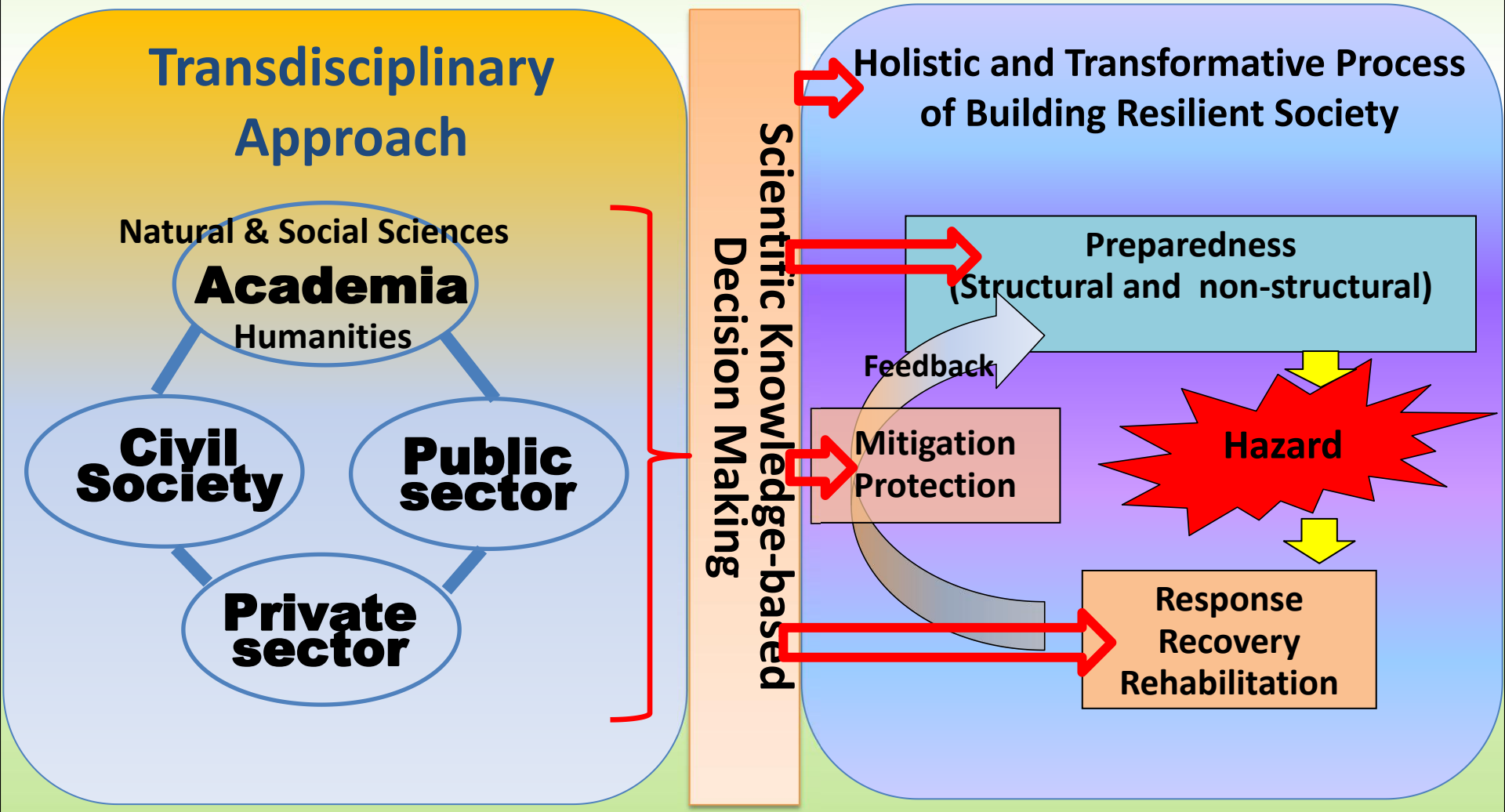
Objectives

- 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)

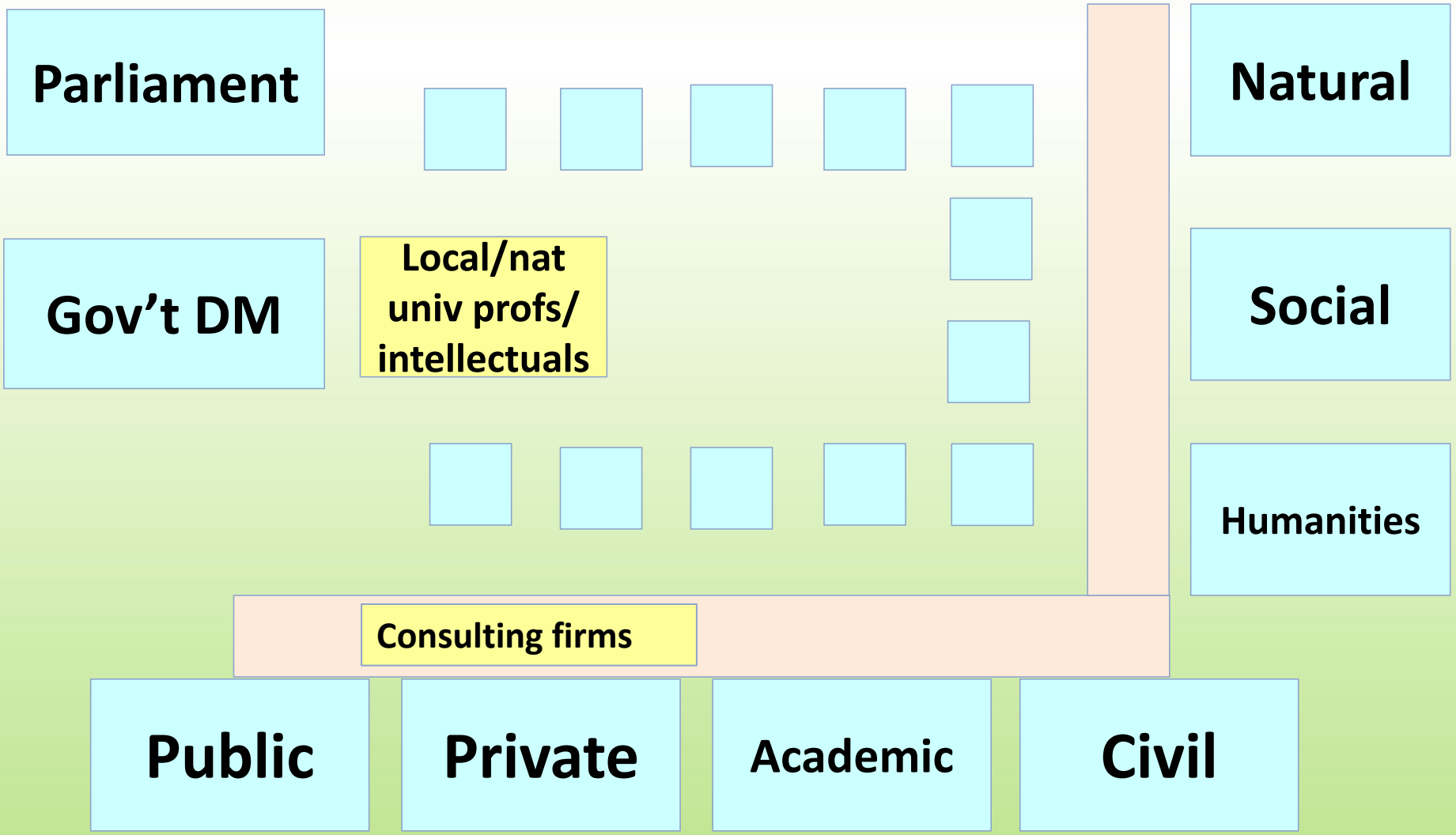
Transparency in decision making

Full societal support for implementation

Some case studies

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

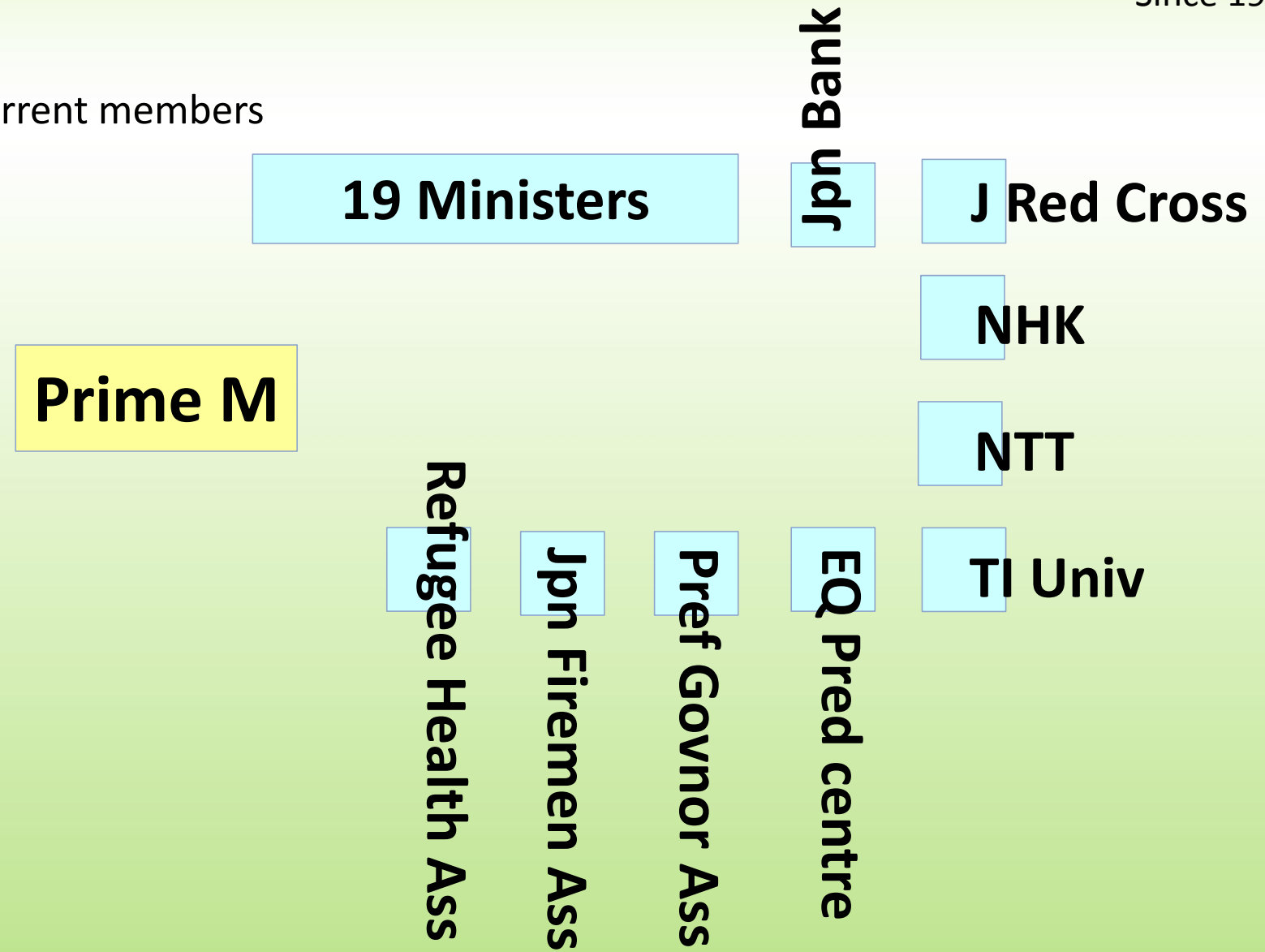
Typical mechanism for scientific knowledge based DM



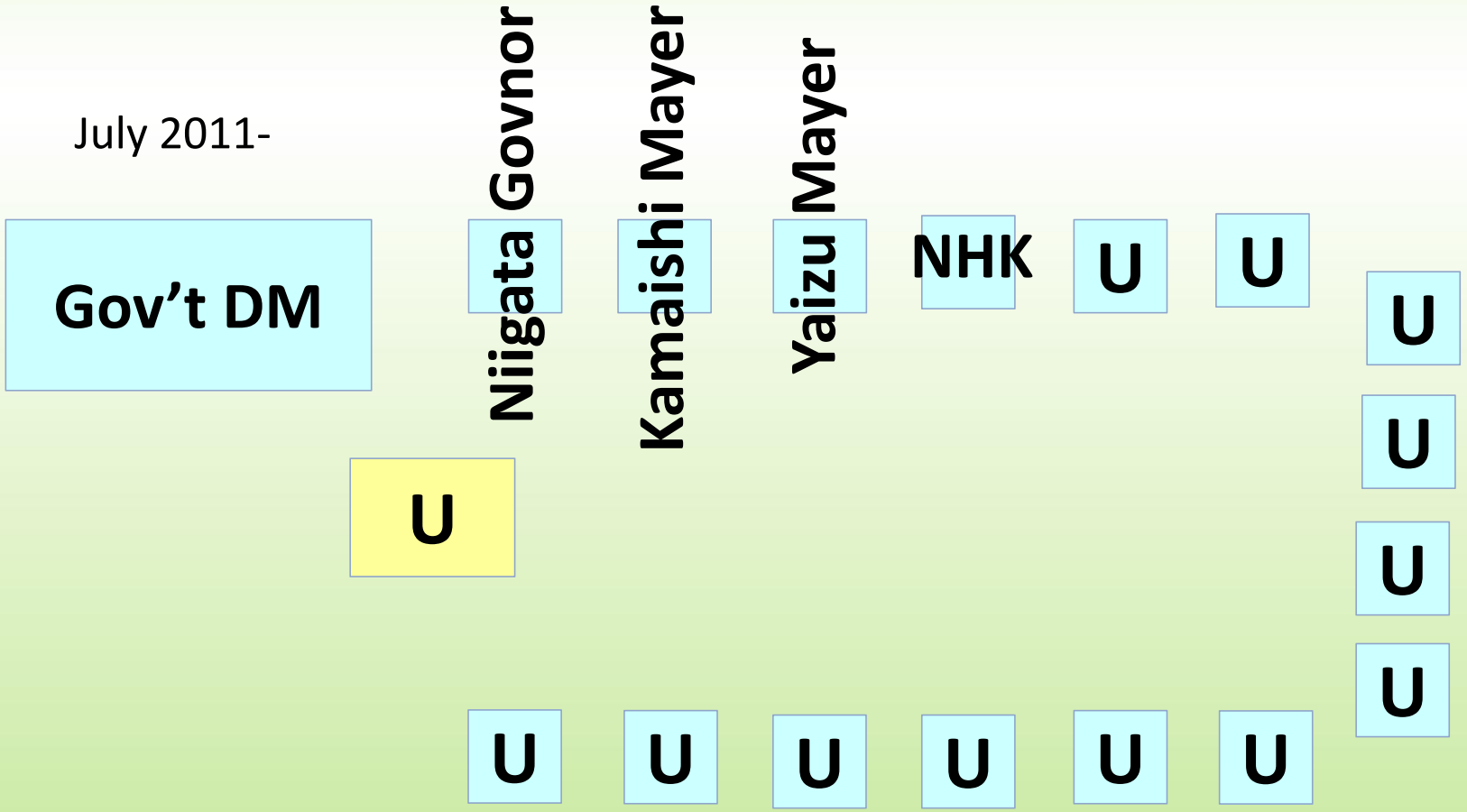
CO Central Disaster Management Council

Since 1961

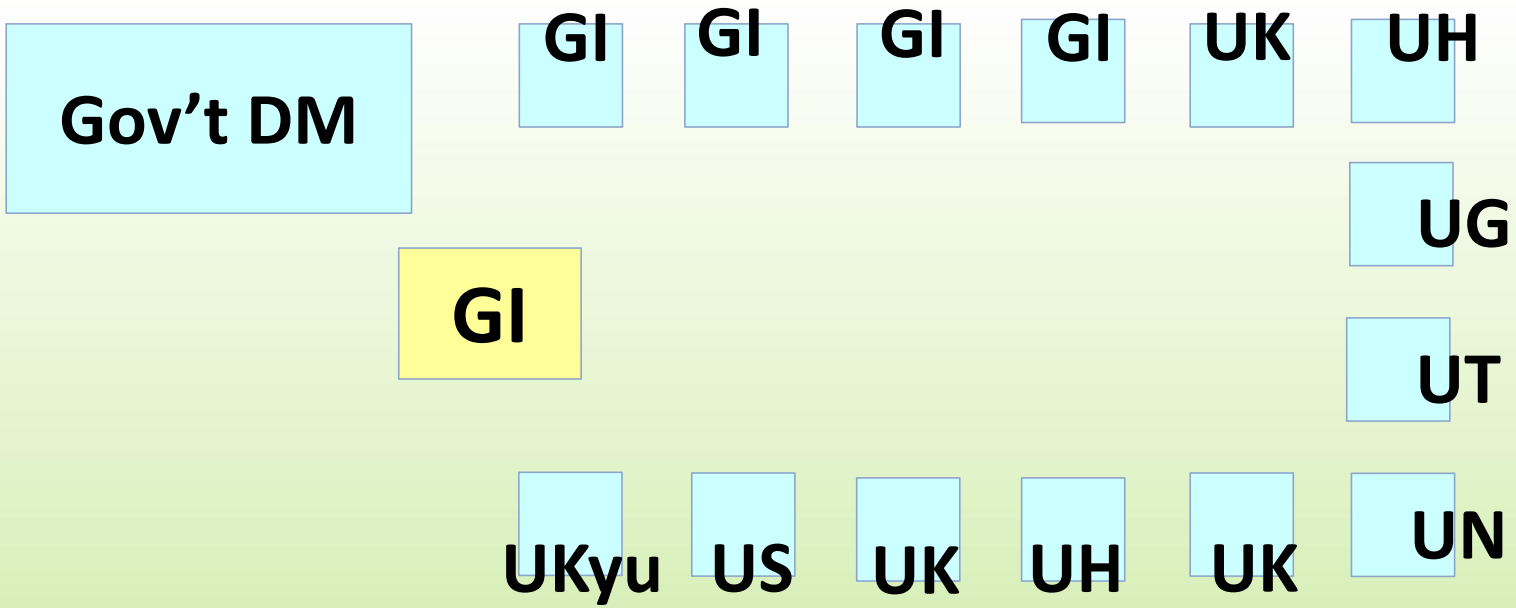
Current members



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



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

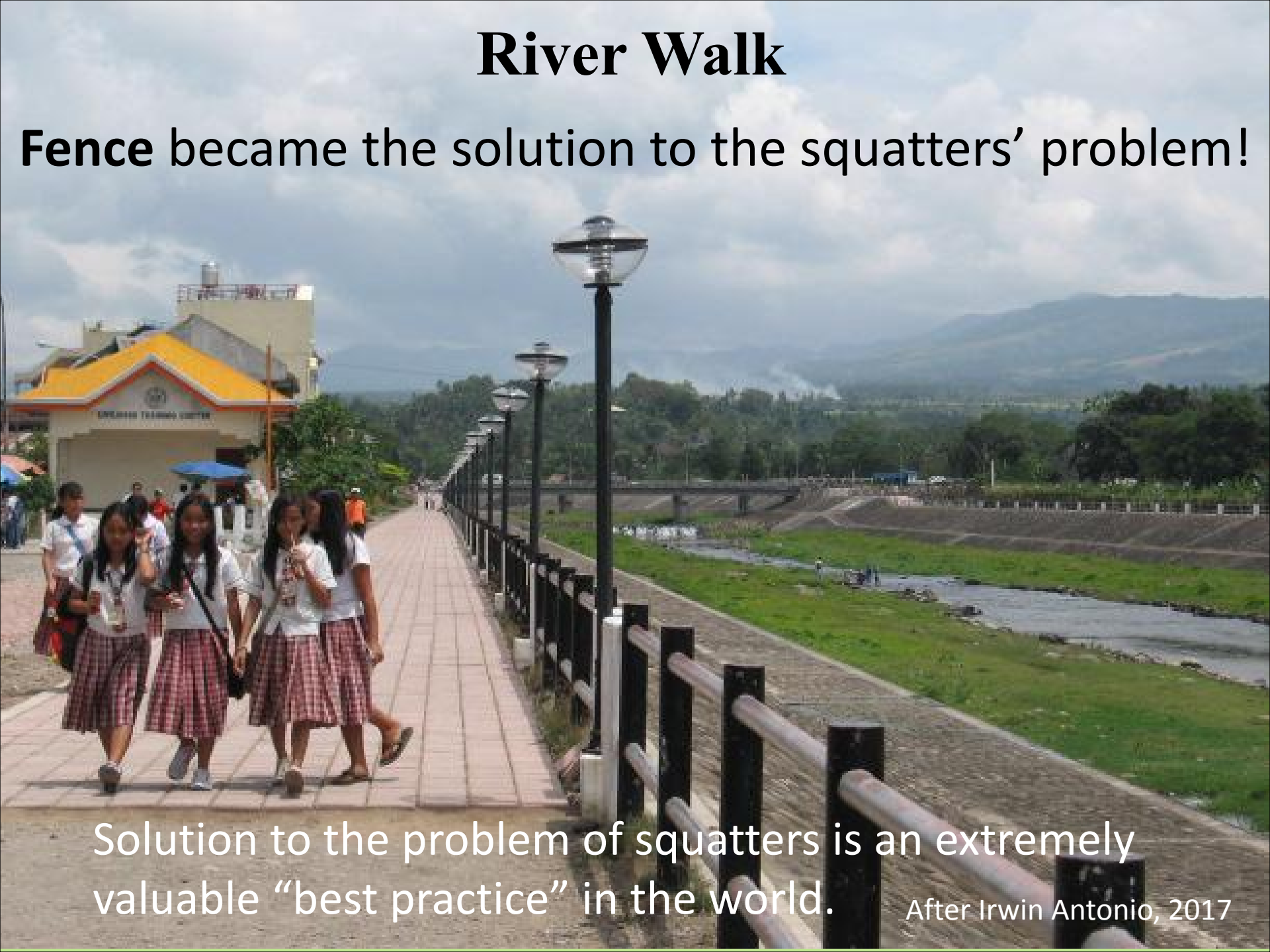

Houses above the revetment


Rest house under the bridge


Blocked drainage due to house extension

River Walk

Fence became the solution to the squatters' problem!



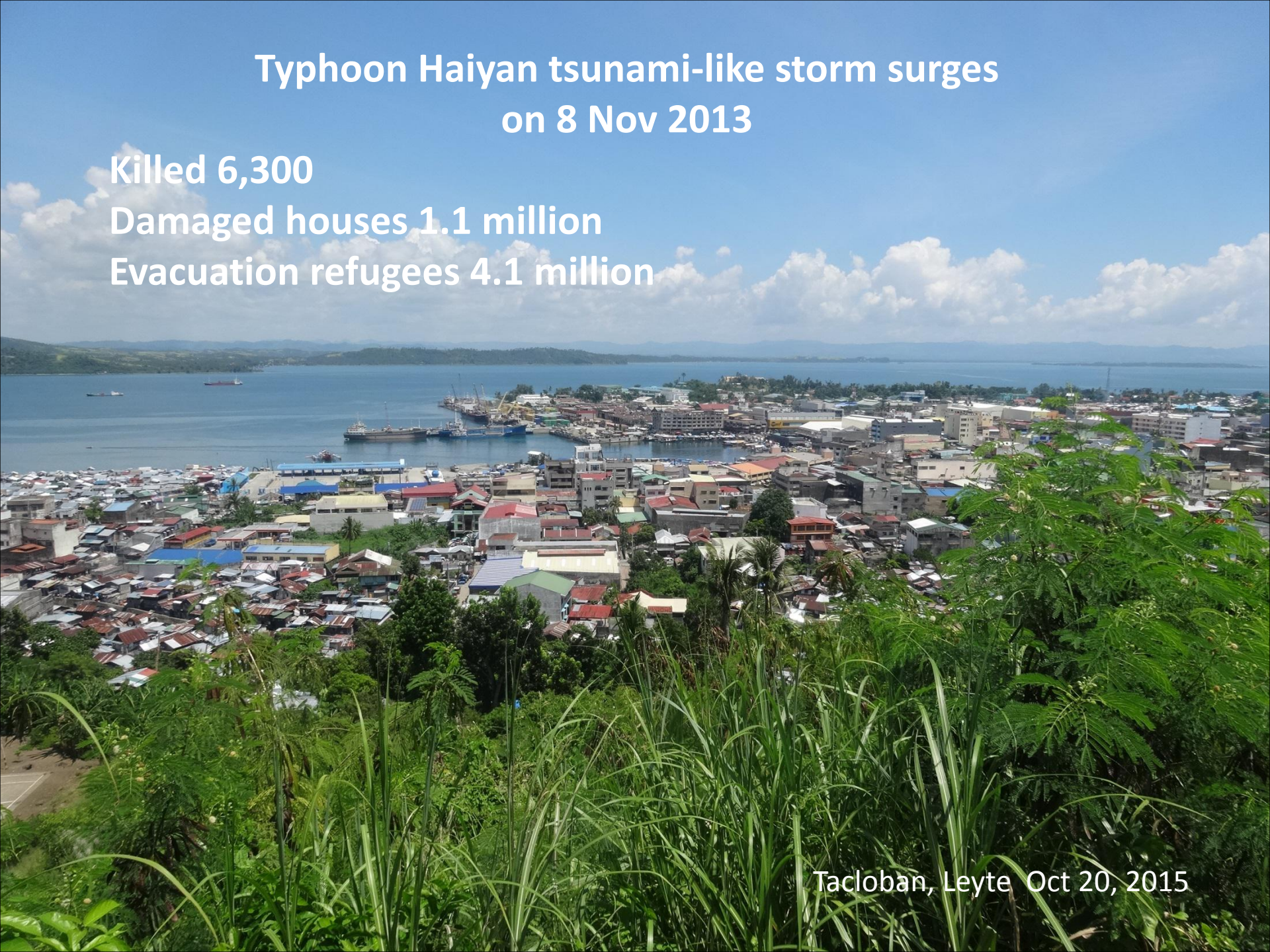
Solution to the problem of squatters is an extremely valuable "best practice" in the world.

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


40M NO BUILD ZONE

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

Intensive consensus building process involving 138 barangay chiefs

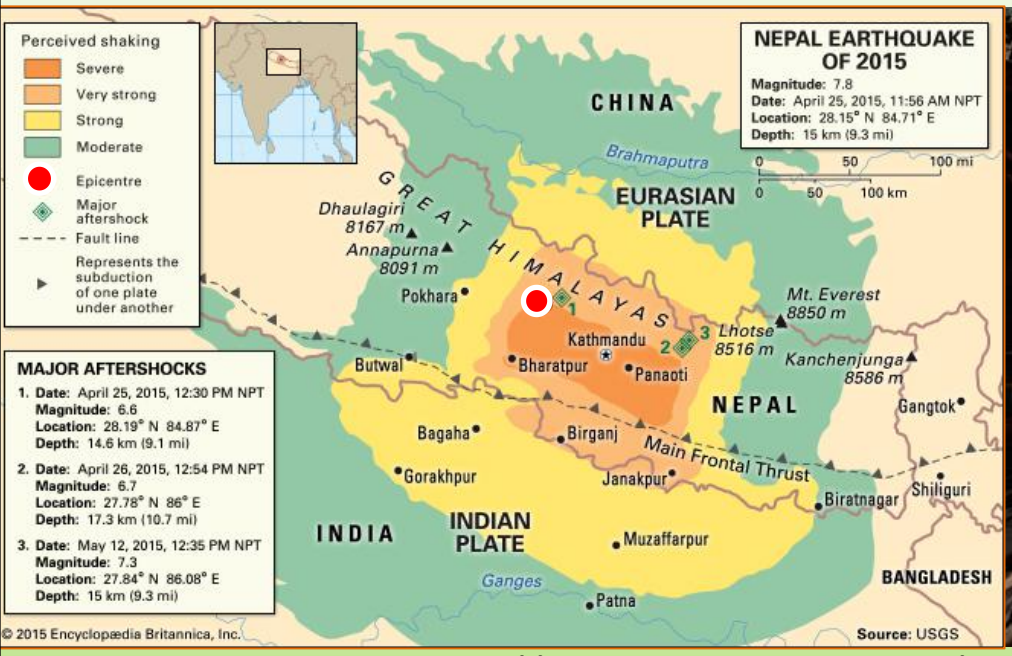
Site Survey in Nepal, April 2017

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)



https://www.britannica.com/topic/Nepal-earthquake-of-2015

Dept. of Urban Development & Building Construction (DUDBC)

National Reconstruction Authority (NRA)

A sill and lintel band method

300k Rupee Grants Subsidy

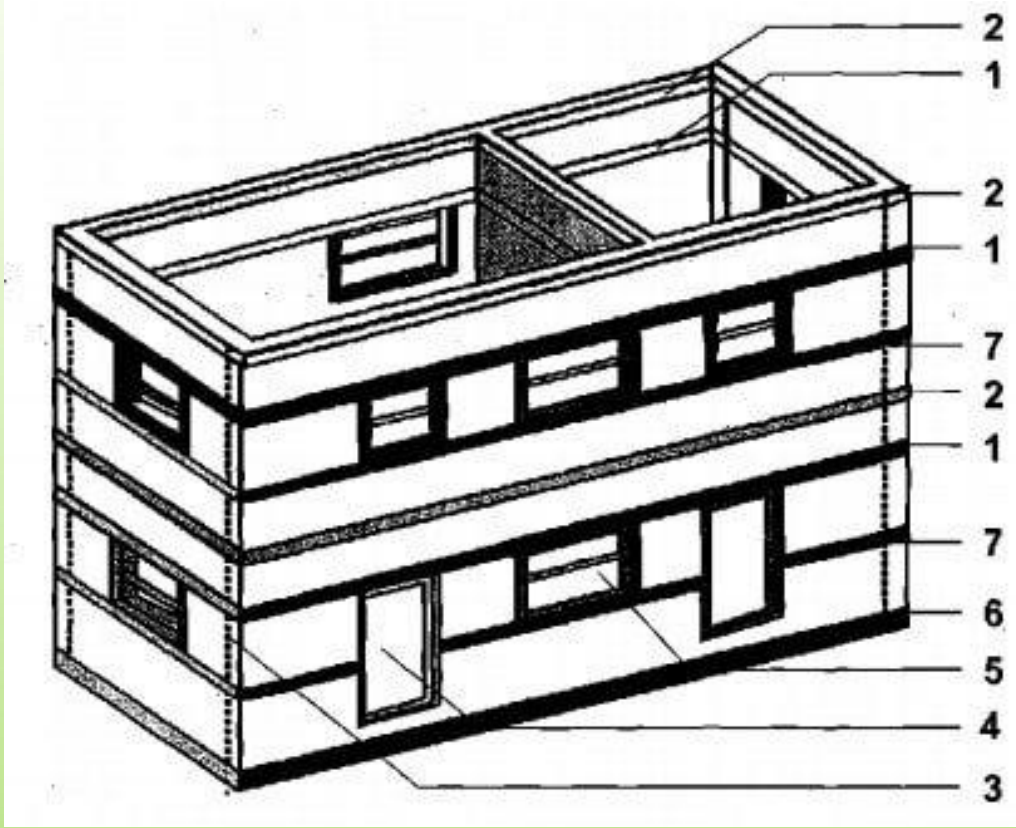
With	agreement	50k,
	print	150k,
	roof (band)	100k

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

Public

Academia

Finance

Cap Buil

Civil soc

Dr. Youb Raj Paudyal, DUDBC, Chautara, Nepal, 23 April 2017

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