Trends and impacts of flood and tsunami in vulnerable Coastal Urban

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Urban Flooding and Tsunami risks: Trends, Impacts and Policy implications

1. Rapid Urbanization in many developing countries increases flood and tsunami risk
   - Most developing cities in rapid urbanization locate in Coastal Low n Flat
   - Massive informal settlement onto marginal spaces makes things worse
   - Basic services of drainage and solid waste management are inadequate
   - Proactive measures are not mainstreamed into urban planning process
   - Capacity of forecasting, warning and evacuation is poorly enhanced
   - Climate Change may cause sea level rise and strong storm surges
2. Japan experienced in strengthening urban flood resilience under the most rapid development in the latter half of 20th Century
   - Expanded flood management over all watershed to keep runoff control
   - Comprehensive measures both by public and private sectors
   - Strong legislation of flood control, monitoring and reporting
3. City managers and policy makers in developing countries need to:
   - Aware the fact of aggravating Urban Flooding
   - Learn lessens from evidences of comprehensively grown history of urban flood prevention in advanced nations
   - Implicate the robust concept into the city development policy without diminishing urban resilience against the flood hazard
4. A case study on Jakarta Comprehensive Flood Risk Management
   - Integrating all activities into one story of flood free city development under coordination of basin wide, sector crossing and stakeholder participated
5. Lessons from recent Tsunami disasters
   - The earthquake off the west coast of Northern Sumatra and the giant tsunami in the Indian Ocean, Dec.26,2004.
   - The Great East Japan Earthquake and Tsunami, March 11, 2011

Increasing risk of Flooding and Tsunami

Trend and impacts of flood, storm surge and tsunami in developing countries

- Rapid urbanization in Coastal Low n Flat
- Massive informal settlement
- Inadequate drainage and solid waste management
- Land subsidence mainly by increasing groundwater extraction
- Not adequate risk assessment in urban planning
- Lacking capacity of risk management of forecasting, warning and evacuation
- Climate Change

- Decreasing storm water retention capacity
- Increasing peak runoff, peoples vulnerability and flood damages
- Rising risks against flood and tsunami

Urban flood risk management in Japan

Good practices of urban cities

- Expanded flood management not only in river courses but also over all watershed to keep runoff control
- Comprehensive measures both by public and private sectors
- Robust system of flood control, monitoring and reporting legislated by special law for urban flood management

Common ideas of risk management in Asian monsoon climate

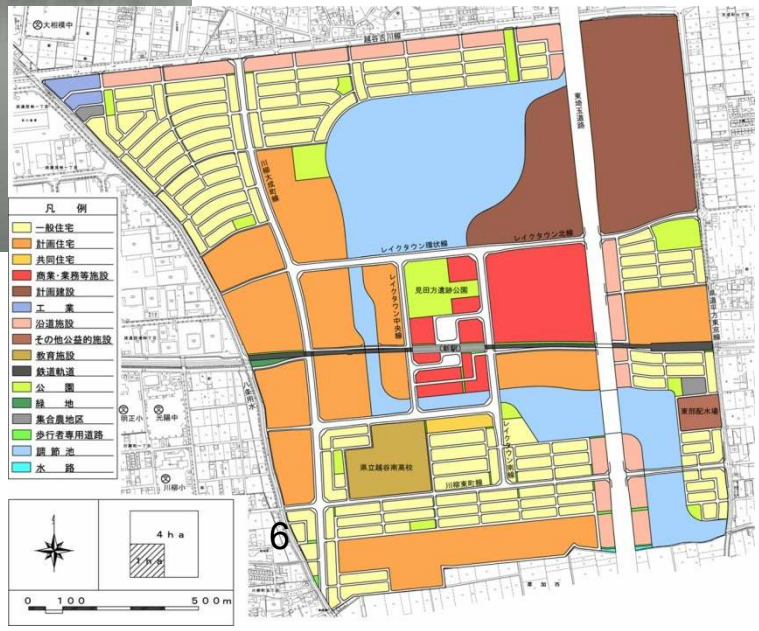
- For flood vulnerable cities developed in low lying coastal prone areas
- Knowledge of risk management for seasonal flooding by Typhoon/Cyclone

Tsurumi River Multipurpose Retarding Basin

Retarding pond in urban development of private sector

KOSHIGAYA LAKE TOWN

Public site	Area(ha) Rate(%) road 32.8 15 park 6.9 3 Regulating Pond 38.9 17 total 78.6 35
Private site	Housing 98.9 44 Public facilities 21.1 9 others 27.0 12 Total 147.0 65
	total 225.6



Development of multi purpose retarding area (parks and other public facilities)

New framework of urban flood control

River Law

Flood Protection Law

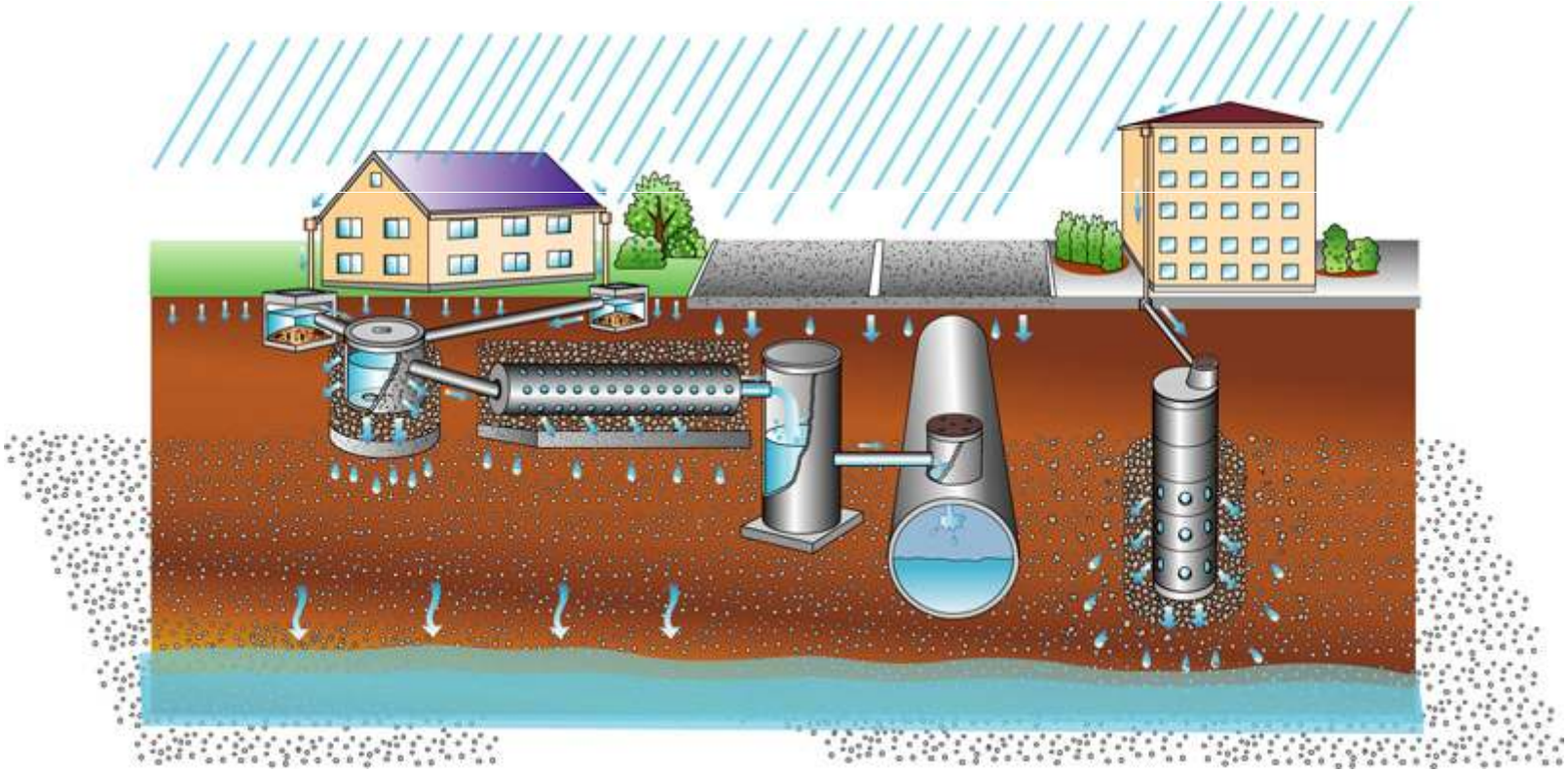
Flood Damage Control Law for Specified Urban River Basins

(Law No.77, 2003)

-Spatial distribution of measures that cross over the conventional Laws
-Obligatory installation of flood control facilities
-Obligatory reporting of actions and operations
-Administrative agreement among local public organizations
-Cost sharing rules

Standard structural measures under ground

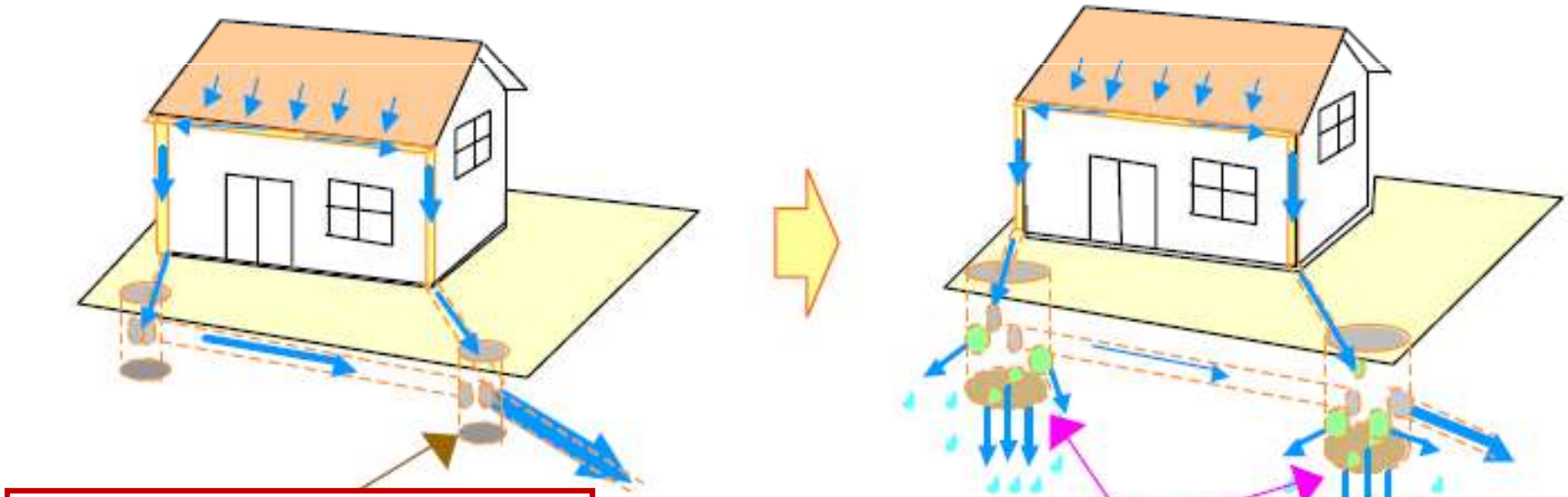
Article 6 Development / maintenance of facilities for retention and infiltration of storm water by ‘river administrator’



Individual house owner's obligations

Article 8　Special technical standard on drainage facilities

Example;　Infiltration in each private house



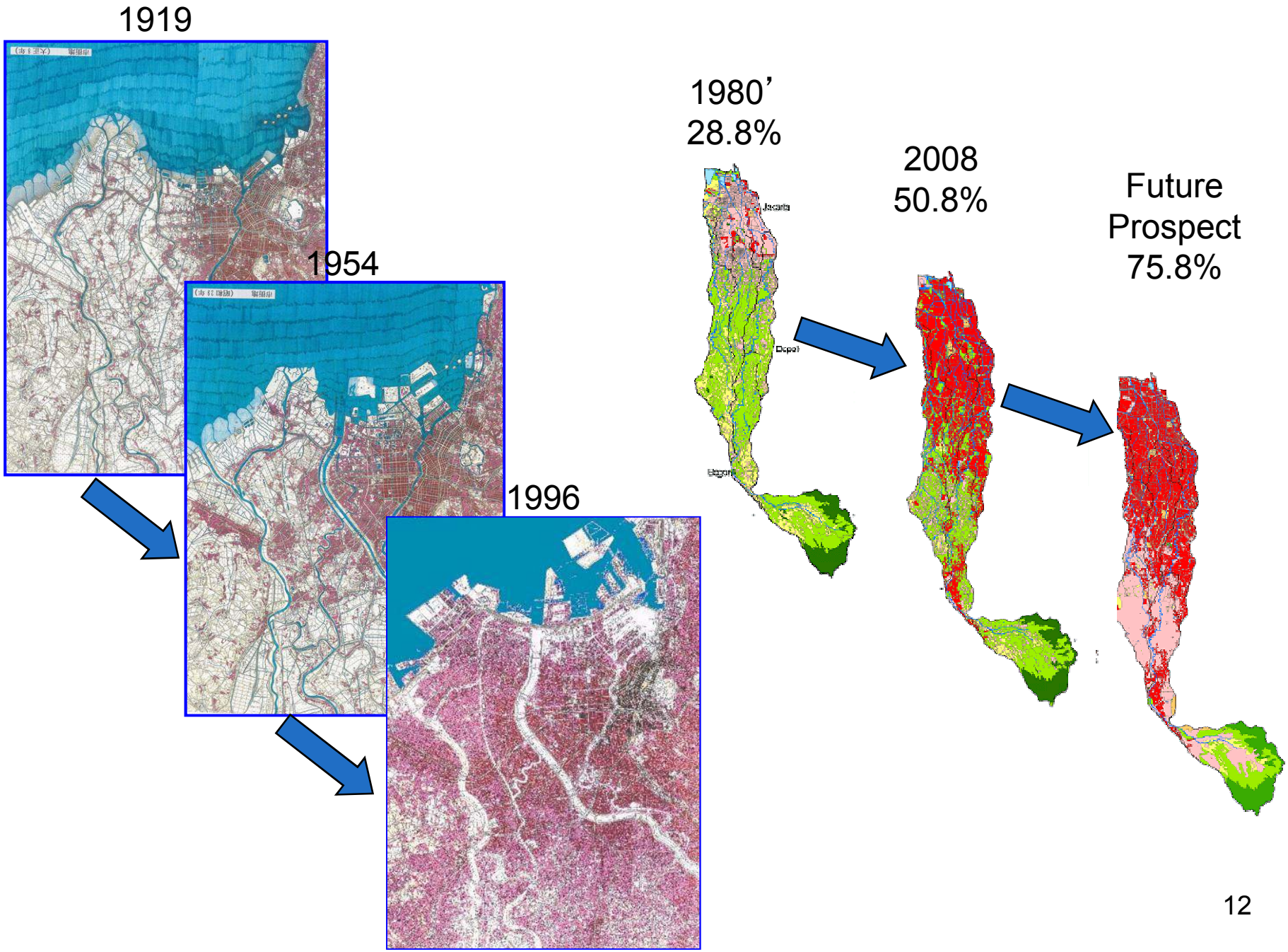
Regular storm sewer

Improved storm sewer
with Infiltration function

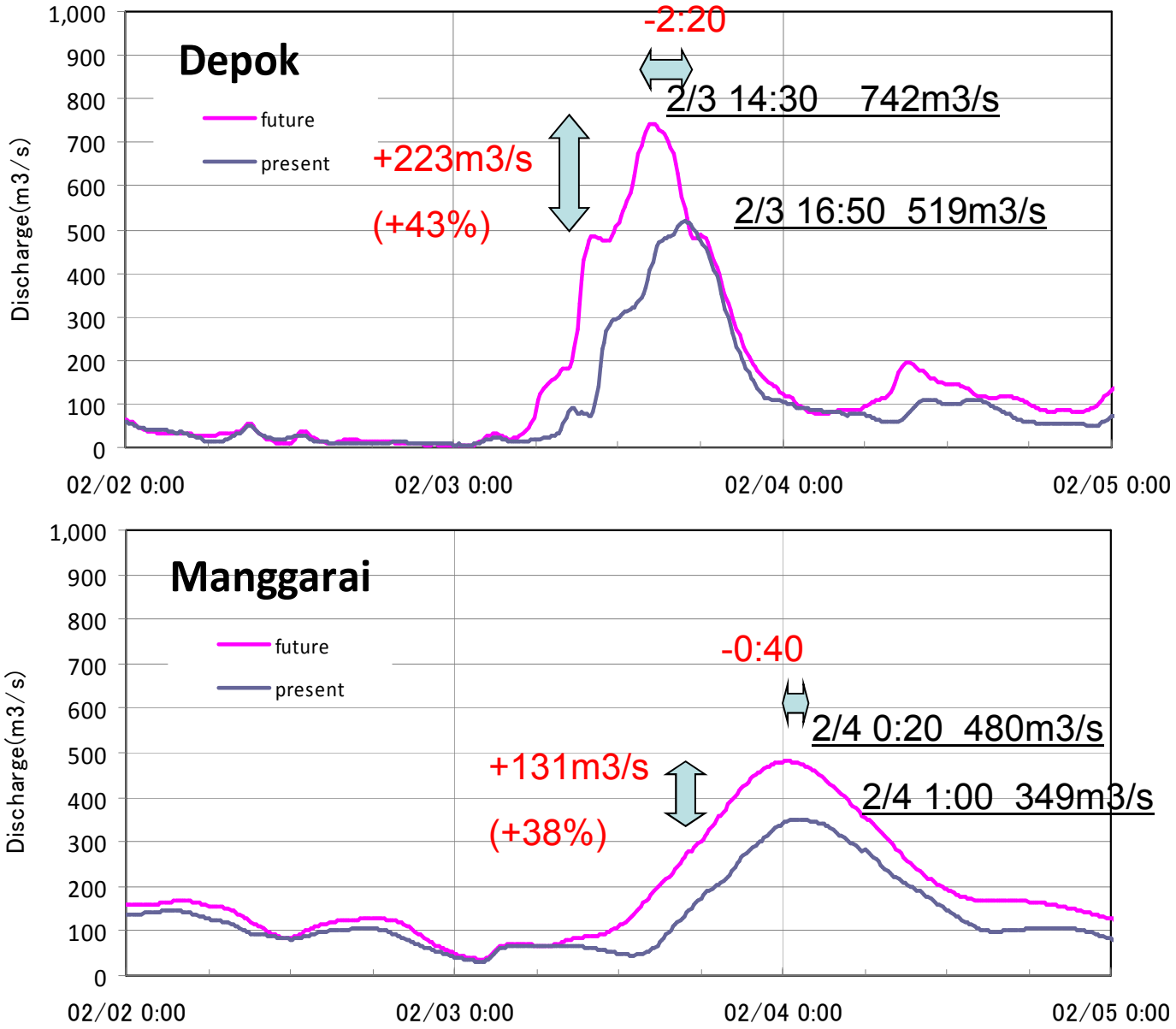
Trends of Urban Floods in Jakarta, the Most metropolitan city in Indonesia

Located in **deltaic areas,** the city is increasingly confronted with flooding mainly caused by :

1. **Land subsidence**, especially in the northern part of Jakarta,
2. **Poor urban drainage** combined with sub standard removal of solid and liquid waste,
3. Change in upper **catchments land use** resulting in deforestation, erosion and reduced water storage,
4. Improper assessment of flood risks in **spatial planning**, and
5. **Climate change**, in particular rainfall intensity and sea level rise


1919
1954
1996
1980’
28.8%
2008
50.8%
Future
Prospect
75.8%

Simulated Discharge Increase due to Urbanization

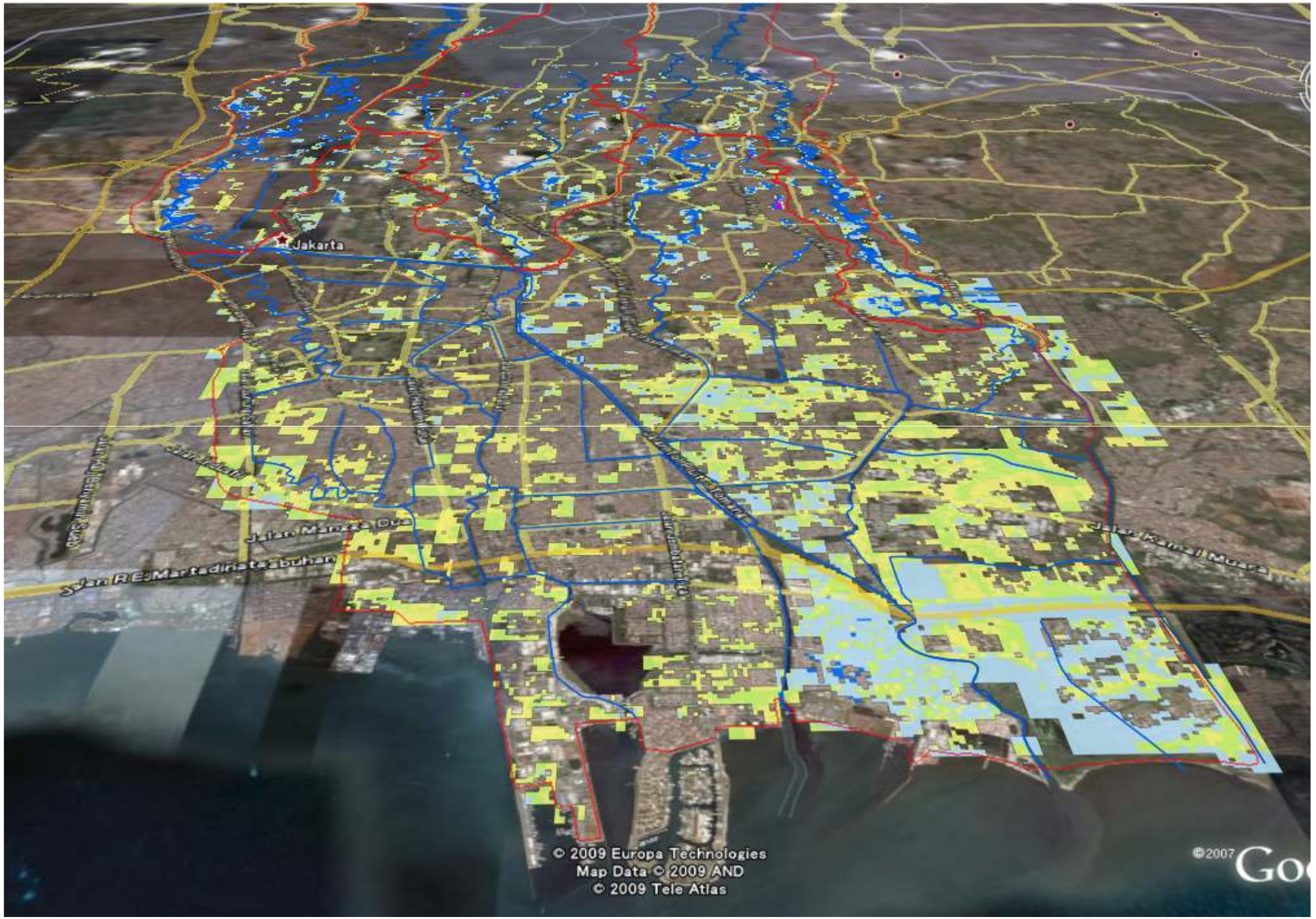


History of Jakarta Flood Management

1. Master Plan 1973
   - Prepared referring to the Jakarta City Master Plan 1965-1985 so that all targets should be finished by 1985.
   - East Banjir Canal (EBC) covering 16.500 ha., West Banjir Canal (WBC) and West Jakarta III drainage system covering 7.500 ha
2. Master Plan 1997
   - Referred to the Master plan 1973 but the capacity of rivers / channels adapted to the new calculation
   - Divided into 8 (Eight) sub river basins and Flood ways
   - Some of the discharge capacity be detained in urban area and partially diverted to outer city
3. JABODETABEK FLOOD MANAGEMENT 2007
   - Structural
   - Non Structural Measures

4. JAKARTA CFM Project from 2010
   - JICA Supported Project
   - Input Japan's experiences to Jakarta

Inundation provable areas in Jakarta, Indonesia



Jakarta Comprehensive Flood Management

- Comprehensive Flood Management
  - All activities are comprehensively formulated into one master plan
  - River administrators, city managers and all relevant authorities are coordinated formally
  - Spatial plan and city development plan take care with flood risk
  - Multi layered measures not only in river course but also over basin

    1.Retarding water in city

    1-1 Development of multi purpose retarding area (public facilities)

    1-2 Improvement of drainage system (ex. Underground tunnel)

    1-3 Polder and Pump Rehabilitation

    1-4 Integrated and efficient management of pumping system

    2.Retarding water in Upper Catchment

    2-1 Developers requirements to make regulating ponds

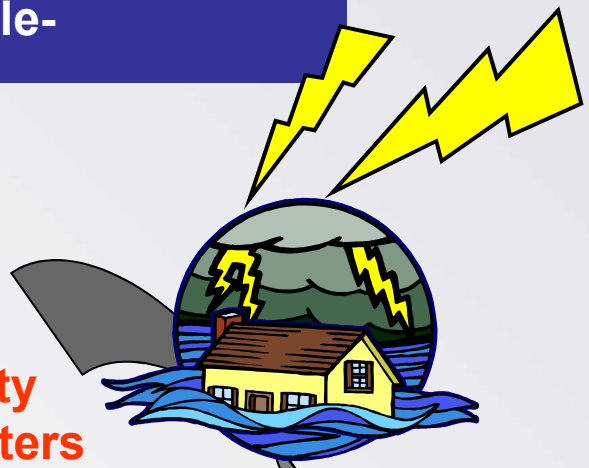
    2-2 Development of multi purpose retarding areas

    2-3 Pond rehabilitation to improve flood retention capacity
- Establishment of legalized system of Comprehensive Flood Management and institutional capacity development
- Extension to other urban cities

JICA' s Approach to Disaster Risk Reduction
-Disaster Management Cycle-

PREPARATION
MITIGATION

Stage1:
Building Strong Community and Society Against Disasters



DISASTERS

Disaster Management Cycle

RESPONSE

Stage 2:
Quick and Effective Response Reaching Stricken Area

RECONSTRUCTION
REHABILITATION

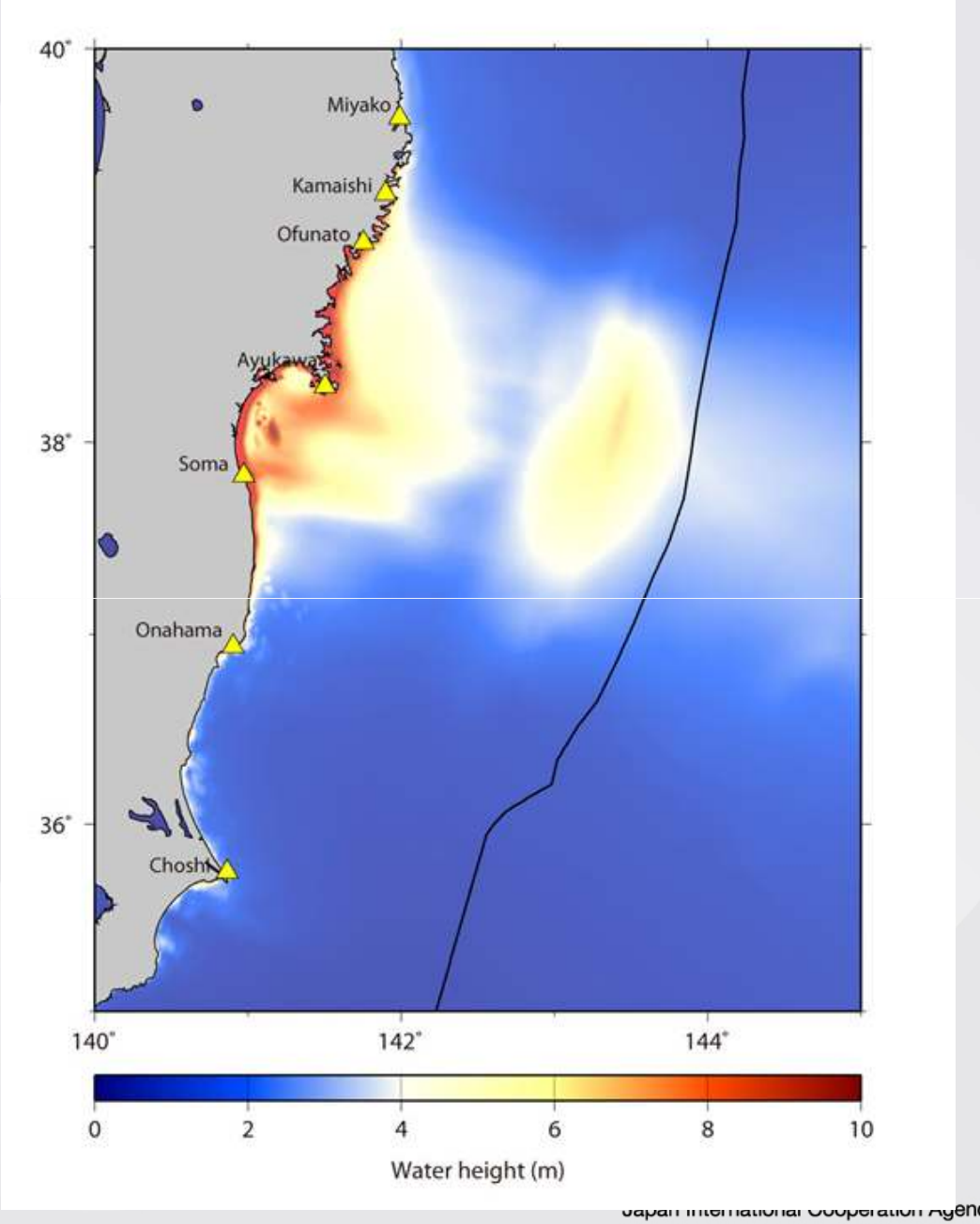
Stage 3:
Appropriate Transition to Reconstruction and Rehabilitation

Maximum Height of Simulated Tsunami near the Source.

Most coastal places were hit by more than 10m height.

by Yushiro Fujii (IISEE, BRI) and Kenji Satake (ERI, Univ. of Tokyo

Source: International Institute of Seismology and Earthquake Engineering (IISEE)



Devastated Rikuzen-takada City.
(source: Asia Air Survey Co., Ltd.)

Railway Bridge washed away by Tsunami wave at
Tsuyagawa Bridge, Kesennuma Line (Photo: JR East)

The number of casualties continues to rise. The Government has confirmed 12,344 people have died. It has already exceeded that of the 1995 Great Hanshin Awaji (Kobe) Earthquake. The number of people who are missing covers only those who have been reported to the police by their families or acquaintances. However, it is likely that there are still thousands of people missing in most severely affected areas that are not yet counted. The number of evacuees has been deceasing as the situation stabilized and services and utilities gradually restored.

As of 4 April 2011

Prefecture	Killed	Missing	Evacuees
Iwate	3,709	4,422	50,202
Miyagi	7,781	6,620	56,386
Fukushima	1,179	3,660	26,061
Others	62	4	23,224
Total	12,731	14,706	155,873

Source: The Emergency Disaster Response Headquarter, National Police Agency

Japan's cabinet office announced on 23 March an analysis that the direct damage to social infrastructure and private housings and facilities by the East Japan Earthquake and Tsunami Disaster is amounting to 2.5 trillion Yen, among which the total damage in three prefectures of Iwate, Miyagi and Fukushima amounts 2.3 trillion Yen.

The number of casualties continues to rise. The Government has confirmed 14,662 people have died. It has already exceeded that of the 1995 Great Hanshin Awaji (Kobe) Earthquake. The number of people who are missing covers only those who have been reported to the police by their families or acquaintances. However, it is likely that there are still thousands of people missing in most severely affected areas that are not yet counted. The number of evacuees has been deceasing as the situation stabilized and services and utilities gradually restored.

As of 30 April 2011

Prefecture	Killed	Missing	Evacuees
Iwate	4,293	3,405	41,058
Miyagi	8,819	6,524	38,501
Fukushima	1,486	1,086	26,232
Others	64	4	21,285
Total	14,662	11,019	127,076

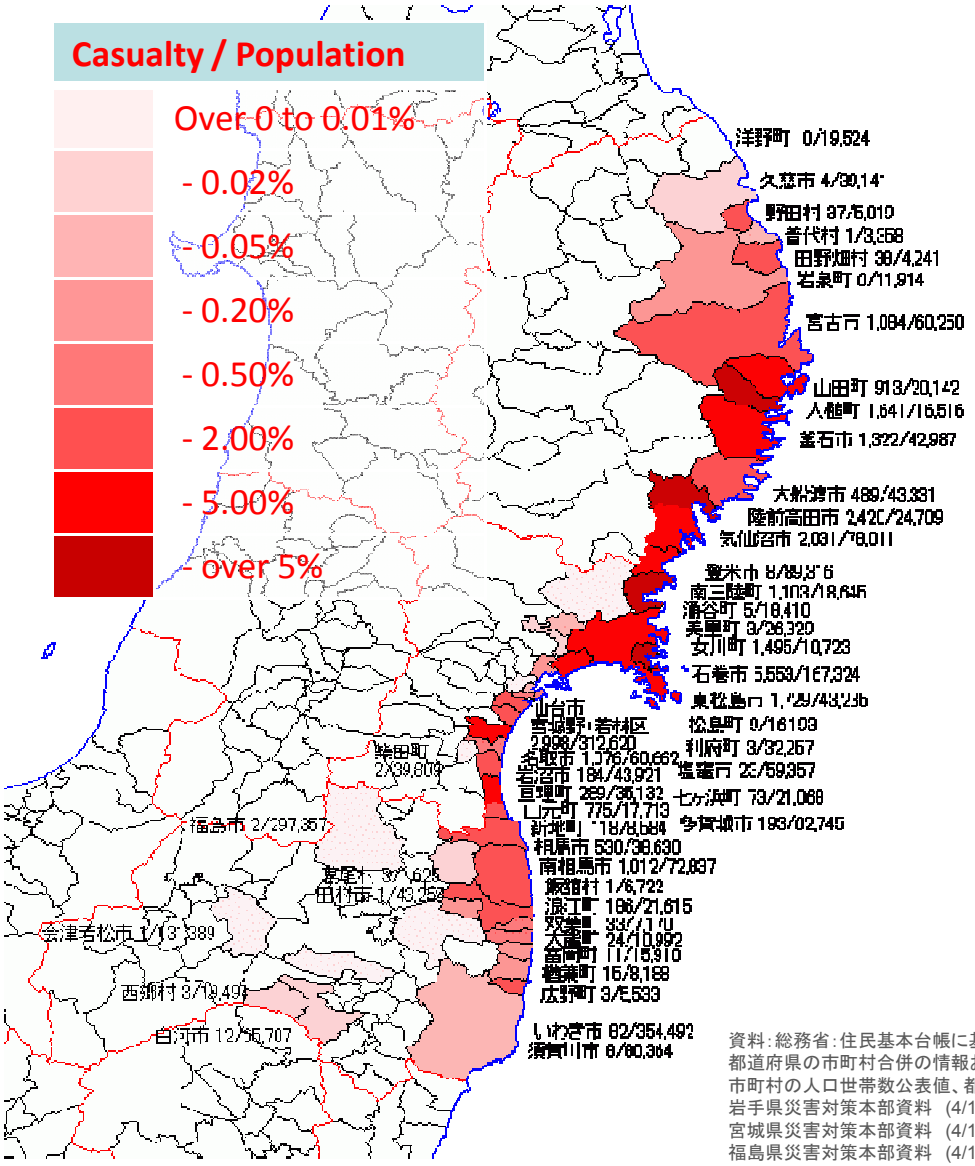
Source: The Emergency Disaster Response Headquarter, National Police Agency

Japan's cabinet office announced on 23 March an analysis that the direct damage to social infrastructure and private housings and facilities by the East Japan Earthquake and Tsunami Disaster is amounting to 2.5 trillion Yen, among which the total damage in three prefectures of Iwate, Miyagi and Fukushima amounts 2.3 trillion Yen.

Some success stories

Although the catastrophic damage over the coastal area of Tohoku was the highest record, some communities were saved from Tsunami by protection walls and gates.
Fudai Village, Iwate, is the one protected by Tsunami Gate, which was constructed at 300m upstream from Fudai River mouth, with 15.5m height, 200m length and 3.6 billion yen in 1984, with consciousness of Meiji Sanriku Big Tsunami occurred in 1896 while more than one thousand casualties were recorded in the village.
The latest Tsunami overtopped the gate and relating embankment, however, ceased at 200m upstream from the gate and ended with no damage on housing area in the village.
(Photo: Nikkei BP)

Vulnerability of urbanization in low coastal area

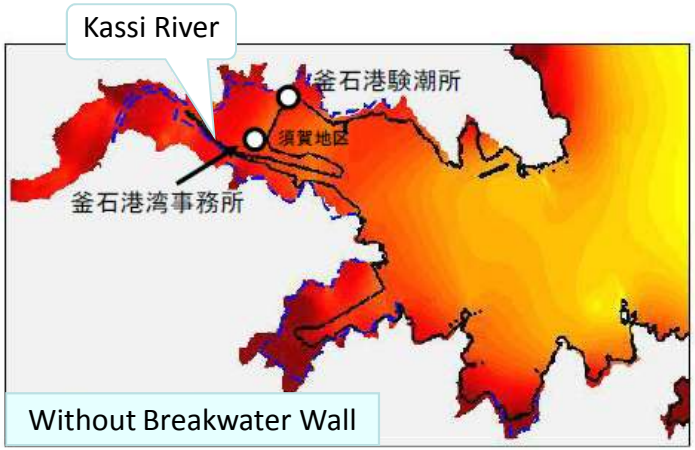


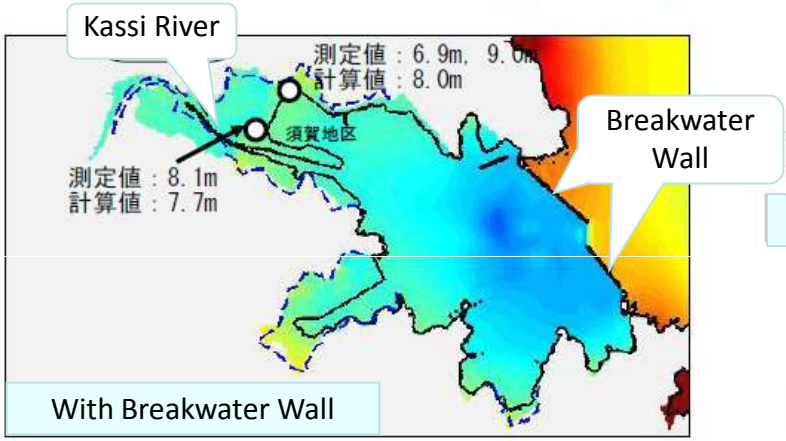
Cities and towns of Ohtsuchi, Rikuzantakata, Minamisanriku, Menagawa have counted high casualty rate against population. Those are all urbanized areas developed in low and flat spaces along coastal inlets.

Some towns were reported as they have evacuated people quickly and effectively without serious casualties. Those success story however can be found in small scale communities where past experiences have traditionally been handed down. In such places, disaster preparedness capacity has been enhanced by schools and local governments with support of universities or NGOs.

It repeatedly highlighted the importance of integrating disaster risk reduction into sustainable development including urbanization of coastal area. The community based disaster management capacity in middle to large scale locality is also a matter we have to improve.

資料：総務省：住民基本台帳に基づく市区町村別人口及び世帯数
都道府県の市町村合併の情報および市町村の合併協議会情報
市町村の人口世帯数公表値、都道府県の統計情報
岩手県災害対策本部資料 (4/15) ・ 総務省統計局ホームページ
宮城県災害対策本部資料 (4/16) ・ 総務省統計局ホームページ
福島県災害対策本部資料 (4/15) ・ 総務省統計局ホームページ





Blue dotted line indicates the far most edge of reached Tsunami, ground traced by PARI

Source: The Port and Airport Research Institute (PARI)

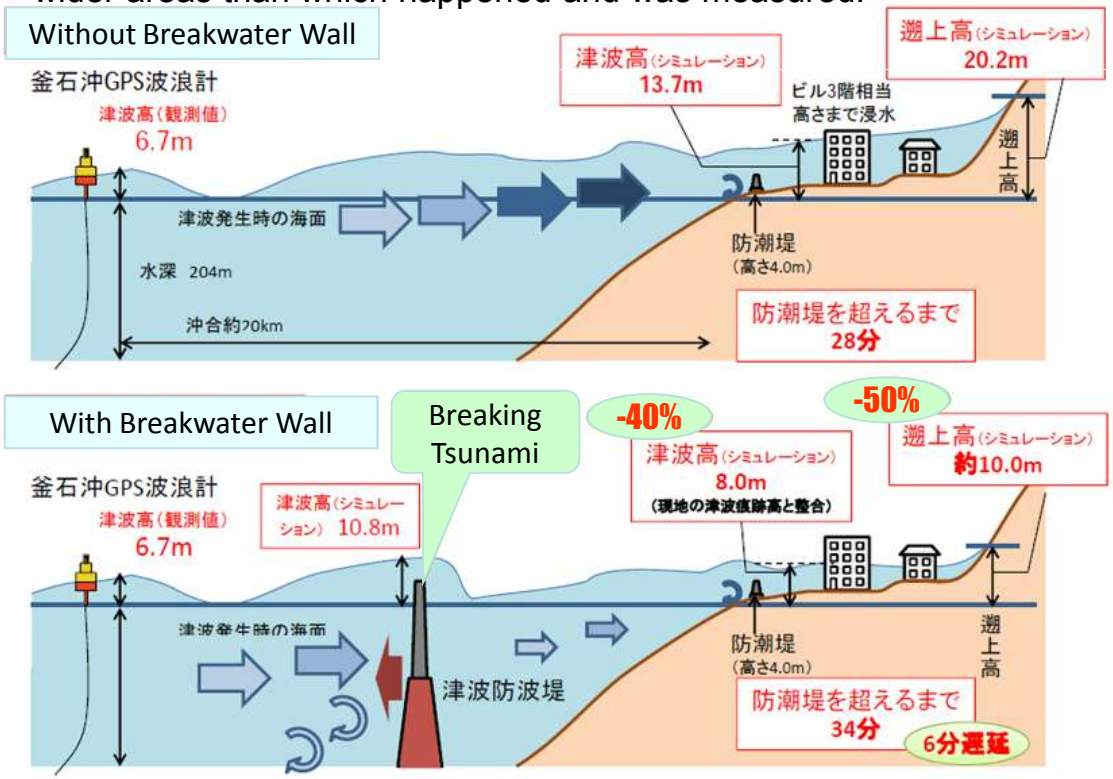
To what extent structural measures were effective?

Kamaishi Port, well known as tsunami resilient port protected by the world largest class breakwater wall, was damaged seriously.

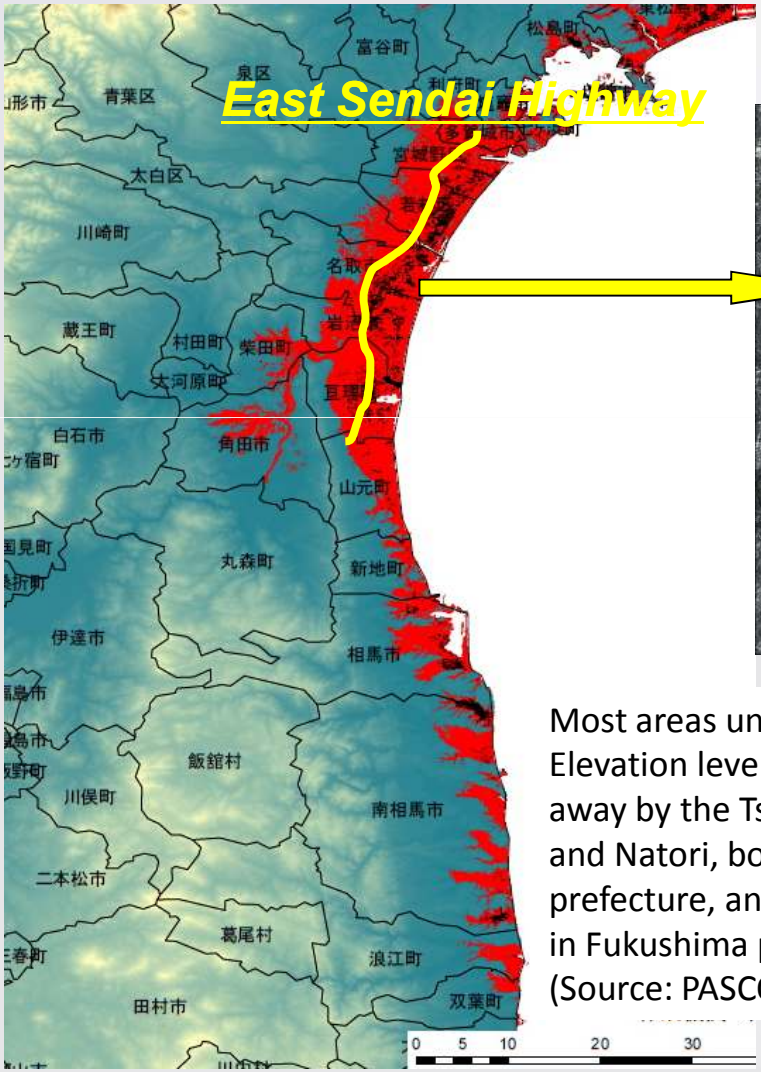
The breakwater wall, which had been standing at the mouth of Kamaishi Bay, collapsed and the Tsunami washed the urban area of Kamaishi City, reaching up to 6.9 to 9m elevation at several points.

The breakwater wall, however, impeded tsunami energy to the extent considerably by 40%.

According to the analysis by the Port and Airport Research Institute, simulated tsunami without the wall would have reached up to 13.7m elevation and would cause further cruel damages in wider areas than which happened and was measured.



High mounted road blocked Tsunami

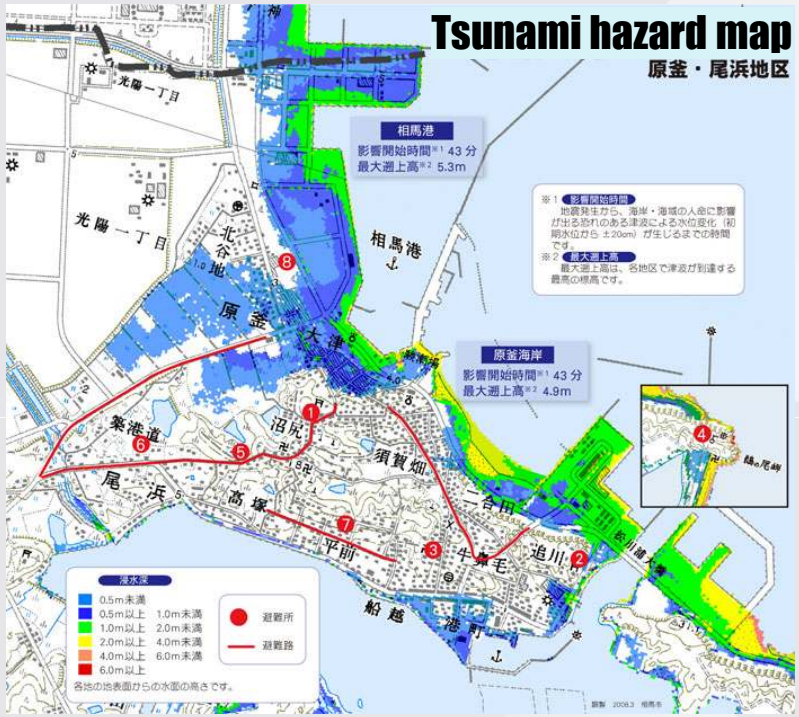


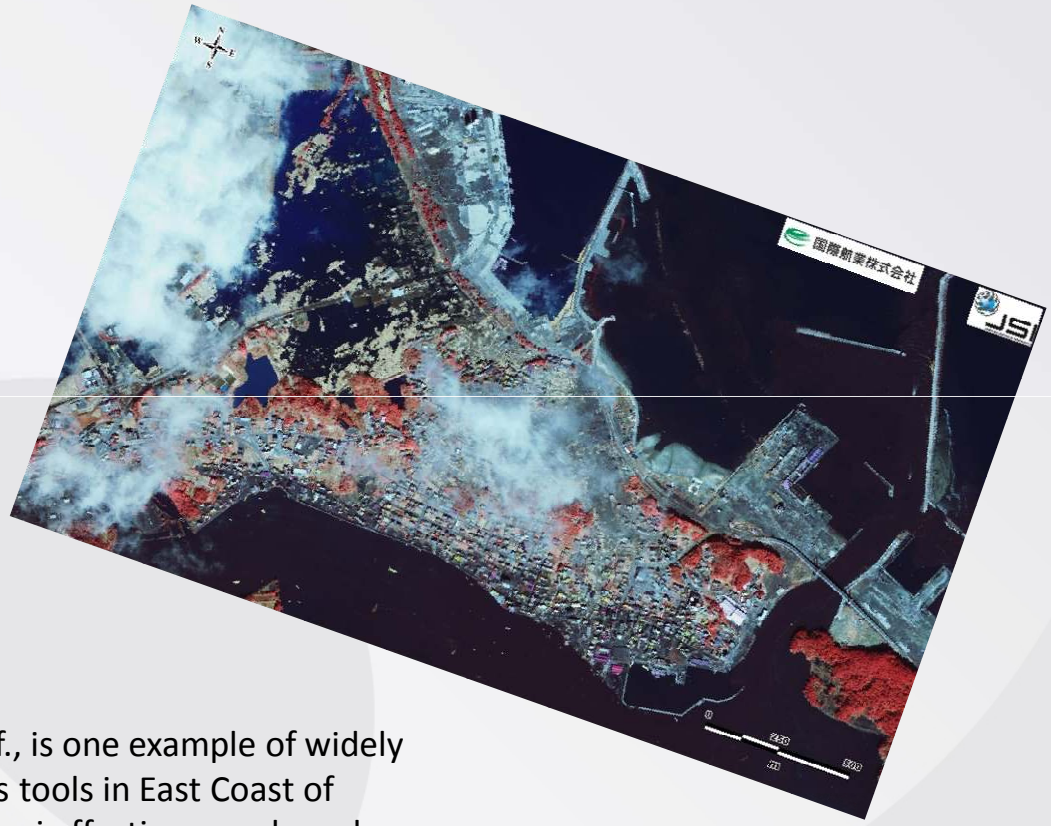
Radar image, taken at 5:38 on 13 March 2011, detects Tsunami affected area where the radar wave get absorbed by inundated water, indicated as red color.
(Source: Kokusai Kogyo)

The East Sendai Highway saved city area from Tsunami by standing as final blockade.

Most areas under 10m Elevation level were washed away by the Tsunami at Sendai and Natori, both in Miyagi prefecture, and northern cities in Fukushima prefecture.
(Source: PASCO)

The Tsunami overloads far beyond preparedness

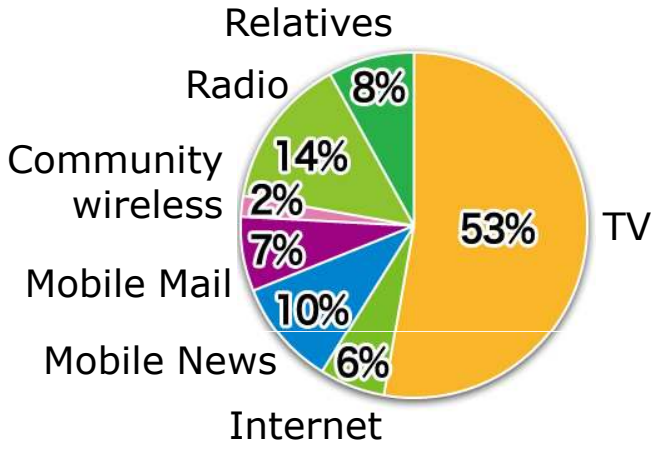




Tsunami hazard map of Soma City, Fukushima pref., is one example of widely distributed and well trained disaster preparedness tools in East Coast of Tohoku, Japan. The map indicates simulated tsunami affection area based on three different earthquakes of magnitude 8.2 at Miyagi Coast, 8.6 at Sanriku Coast that we experienced in Meiji era and 7.7 at Fukushima Coast.
The devastating tsunami in 2011, as shown on the aero photo, overloaded far beyond their design maximum areas prepared in disaster management.
(Source: Soma City)

Evacuation actions, regrettable level

By which Media did you get the Tsunami Alert?



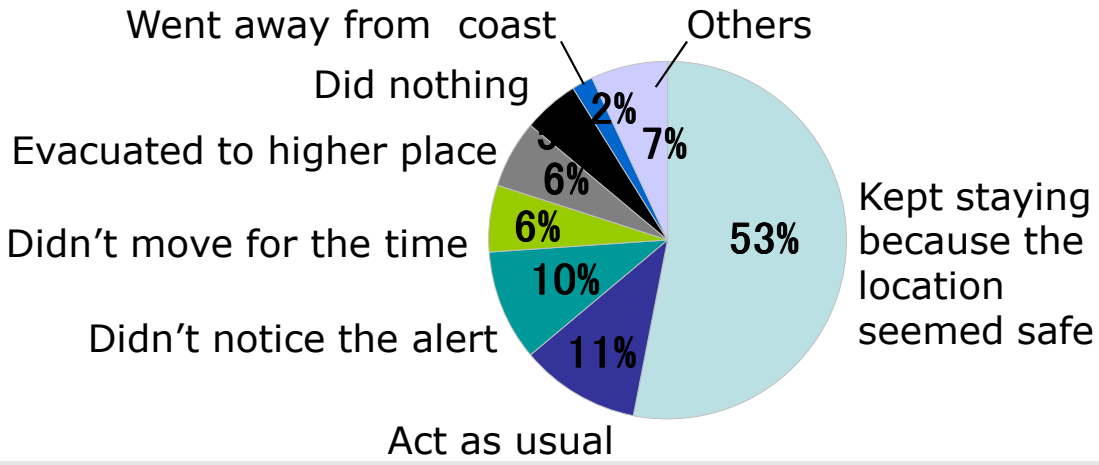
It took about 23.3 minutes in average, for evacuated people in five prefectures in Tohoku Region, to know the Tsunami Alert after the occurrence of the Earthquake. Since the nations' average time duration of alert delivery is 16 to 17 minutes, the Tohoku area seems to have alarming disadvantage.

The most typical information source of Tsunami Alert used by people was TV, followed by internet and relating mail and news services.

Only 6% of people in coastal area have evacuated themselves to higher ground or buildings and 2% have left away from coast.

Source: WEATHERNEWS Inc.

What did you do after the Tsunami Alert?



Rikuzen-Takada

Photo: Kazuhiro Ikeya, Free Writer ©Nikkei BP

Lessons form 3.11 East Japan

- Design high magnitude of earthquake and tsunami for setting target of mitigation measures should not be esteemed as assumption of possible disaster scales for adapting communities' disaster management against hazard occurrence
- Integration of disaster risk reduction into sustainable development in vulnerable coastal low area should be considered with redundant evacuation strategy
- The capacity development of community based disaster management in middle to large scale locality, especially of newly urbanizing society, must be attempted.
- Mega scale disaster needs global coordination of disaster management with prearranged standard resources including terminology, technology and protocols

Thank you.

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