# Infrastructure versus living with risk: the farewell from the notion of man made security

**Junichi Yoshitani**

**Public Works Research Institute, Japan**

Kiyomizu-dera Temple

# Niigata-Fukushima Flood Damage, July 2004

# Typhoon #23 flooding at Yuragawa Oct. 20, 2004

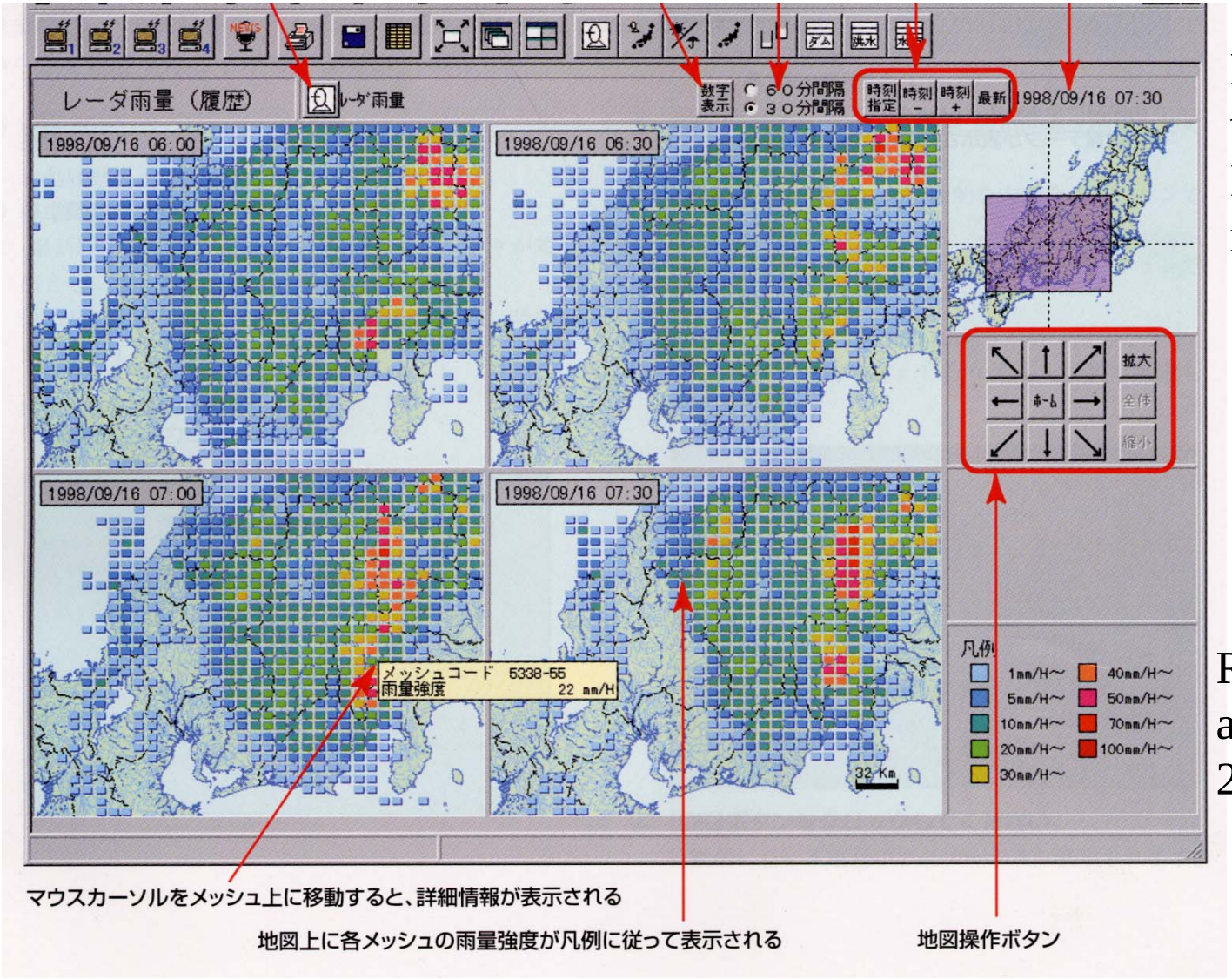
37 people remained on the top of the bus over night.

# Criticism

Local Governments/communities

- did not timely issue evacuation advisory.
- failed to save elderly people (53% of deaths are over 70 years old.)
- were not prepared for flash flood even though hydro-meteorological data are available.

# Example of radar rain observation

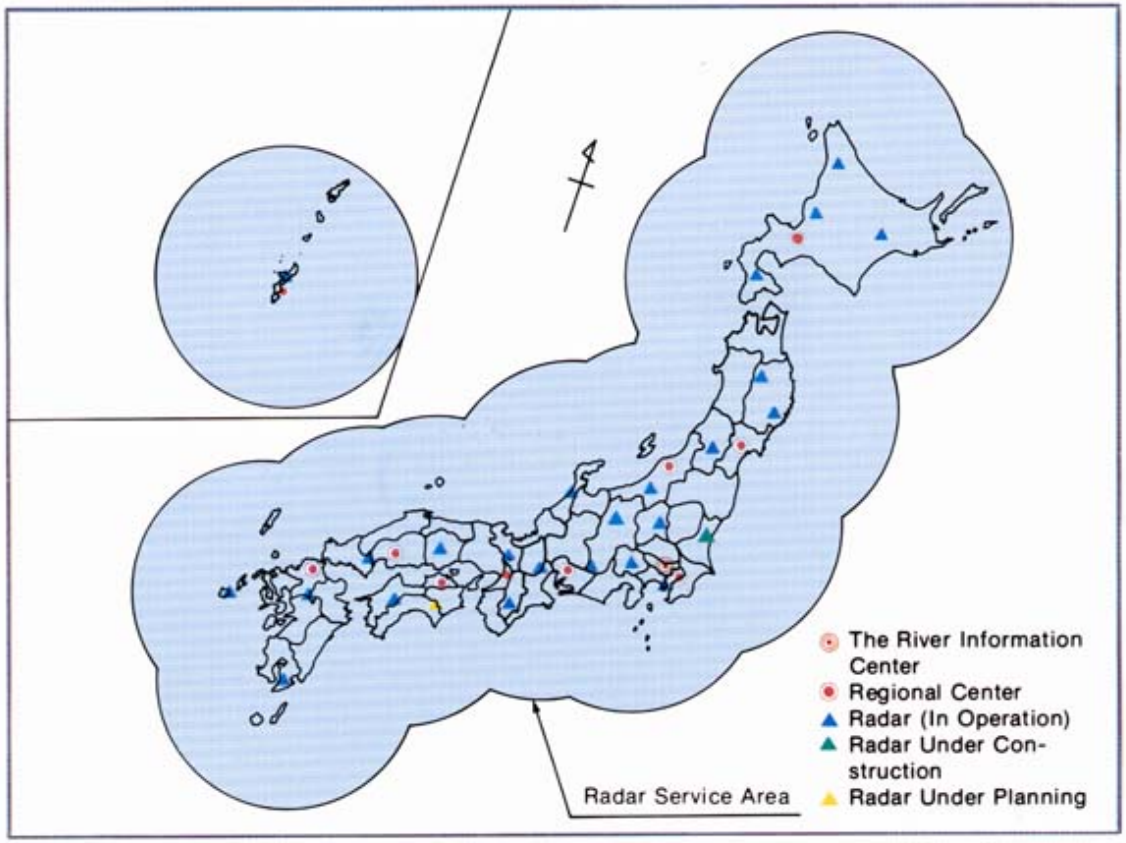



Minimum time Interval: 10 min

R resolution of approximately 20 mm/h

# Radar coverage

**<Radar service area and radars in the country>**




| | Radar sites | Rainfall gauges | Water level stations | Seacoast observation Stations | Water quality stations | Dam | Snow depth sensors |
|---|---|---|---|---|---|---|---|
| Hokkaido | 4 | 205 | 159 | — | 13 | 10 | — |
| Tohoku | 3 | 286 | 275 | — | 22 | 12 | 22 |
| Kanto | 4* | 410 | 476 | 3 | 20 | 9 | — |
| Hokuriku | 3 | 150 | 95 | 3 | 9 | 5 | 21 |
| Chubu | 2 | 433 | 352 | 11 | 15 | 9 | — |
| Kinki | 2 | 292 | 267 | — | 18 | 12 | 3 |
| Chugoku | 2 | 218 | 164 | — | 13 | 21 | 19 |
| Shikoku | 2* | 209 | 134 | 5 | — | — | — |
| Kyushu | 3 | 332 | 227 | 7 | 2 | — | — |
| Okinawa | 1 | — | — | — | — | — | — |
| TOTAL of Ministry of Construction | 26* | 1,616 | 1,179 | 15 | 112 | 69 | 65 |
| TOTAL of Local public bodies | — | 919 | 970 | 14 | 0 | 9 | 0 |
| TOTAL | 26* | 2,535 | 2,149 | 29 | 112 | 78 | 65 |

In addition, there are many prefectual stations.

*include those under planning.
As of April 1997

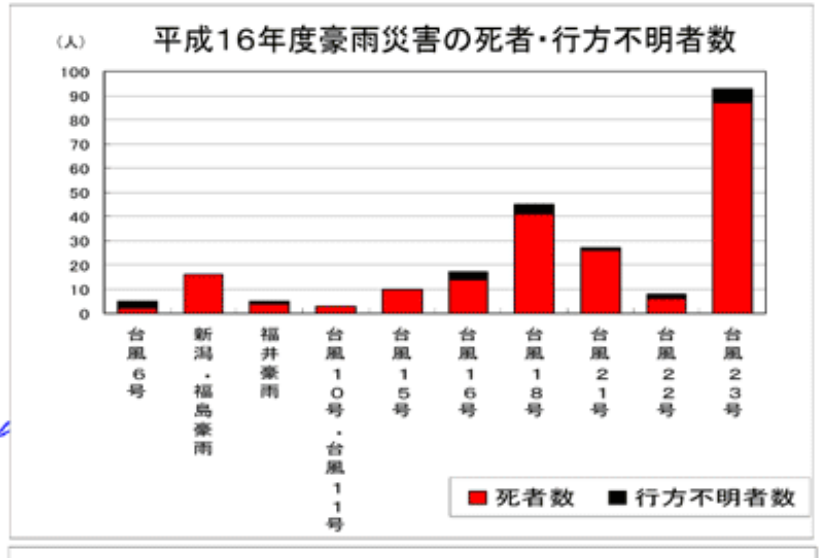
# 平成16年度豪雨災害について

## 平成16年度は観測史上最多の10個の台風が上陸するなど、豪雨災害が頻発

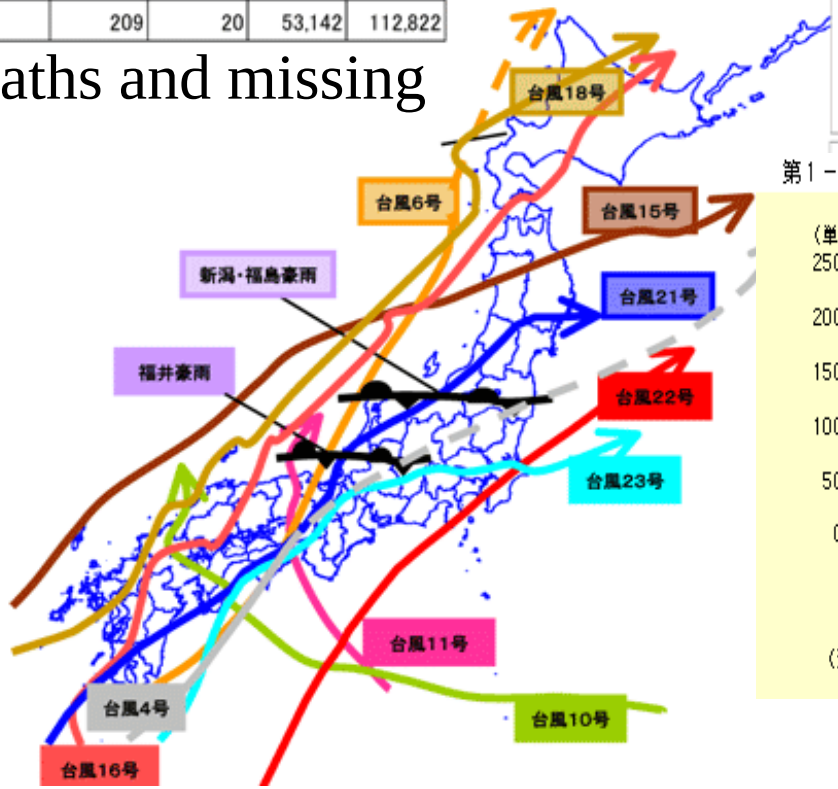
平成16年の豪雨災害による被害

| 事象 | 死者数 | 行方不明者数 | 床上浸水戸数 | 床下浸水戸数 |
|---|---|---|---|---|
| 台風6号 | 2 | 3 | 1 | 41 |
| 新潟・福島豪雨 | 16 | 0 | 2,149 | 6,208 |
| 福井豪雨 | 4 | 1 | 4,052 | 9,674 |
| 台風10号・台風11号 | 3 | 0 | 218 | 2,420 |
| 台風15号 | 10 | 0 | 695 | 2,339 |
| 台風16号 | 14 | 3 | 16,799 | 29,767 |
| 台風18号 | 41 | 4 | 1,598 | 6,762 |
| 台風21号 | 26 | 1 | 5,798 | 13,883 |
| 台風22号 | 6 | 2 | 1,247 | 3,592 |
| 台風23号 | 87 | 6 | 20,585 | 38,136 |
| 計 | 209 | 20 | 53,142 | 112,822 |

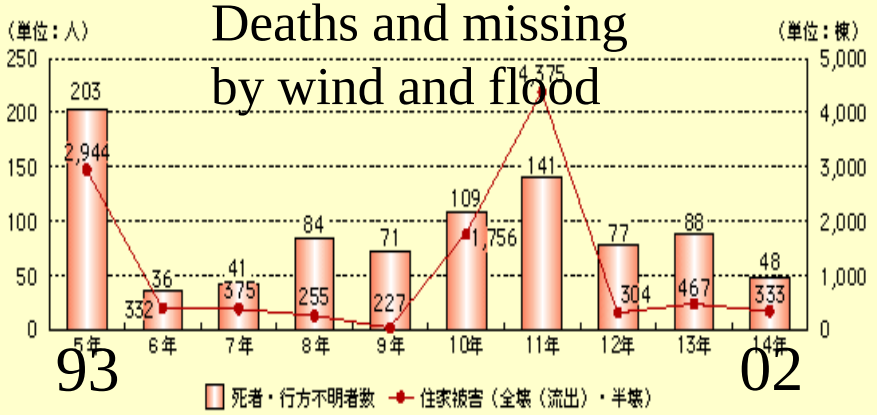
229 deaths and missing




第１－５－１図　風水害等による被害状況




Deaths and missing
by wind and flood

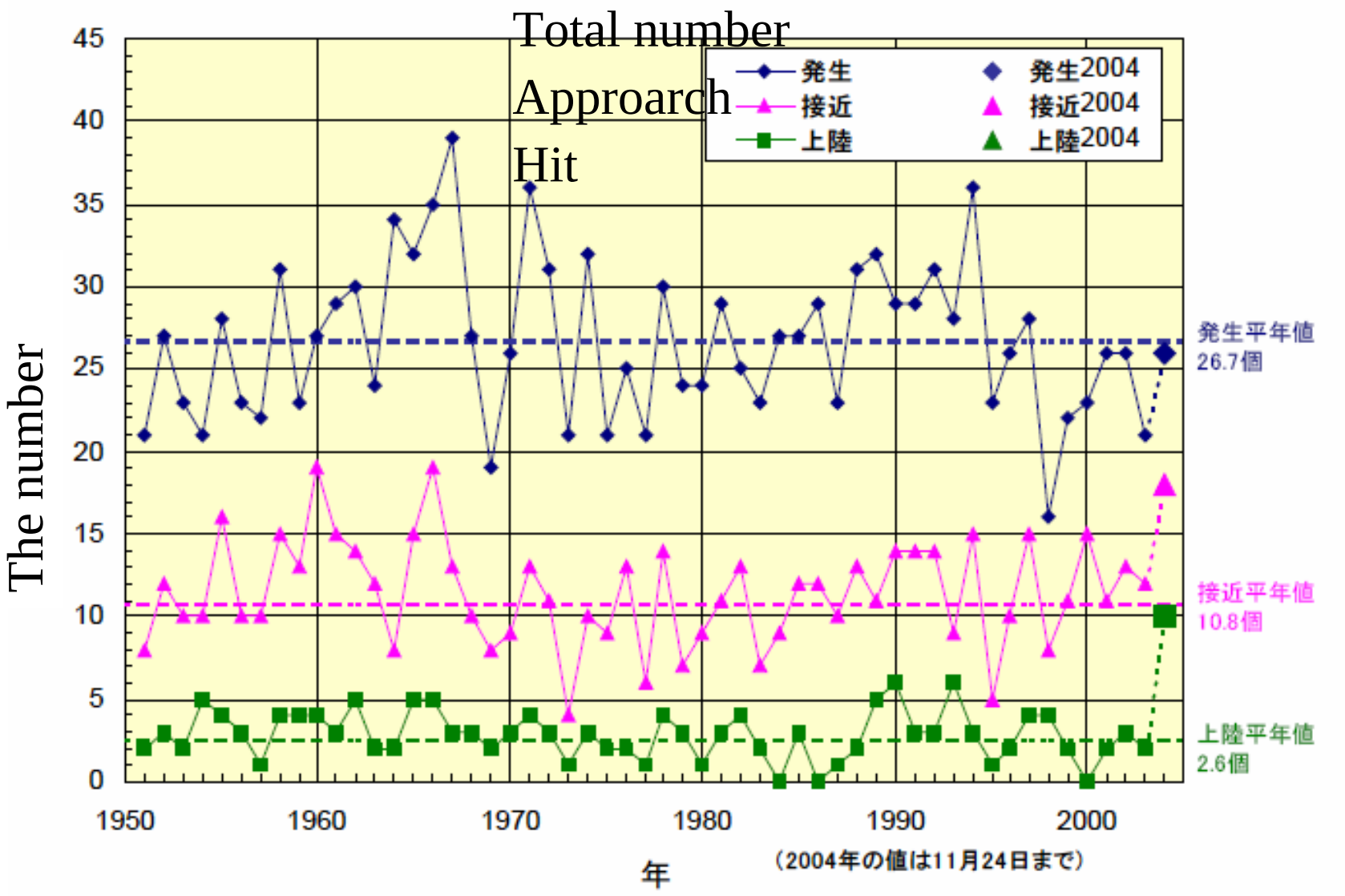



93　　02

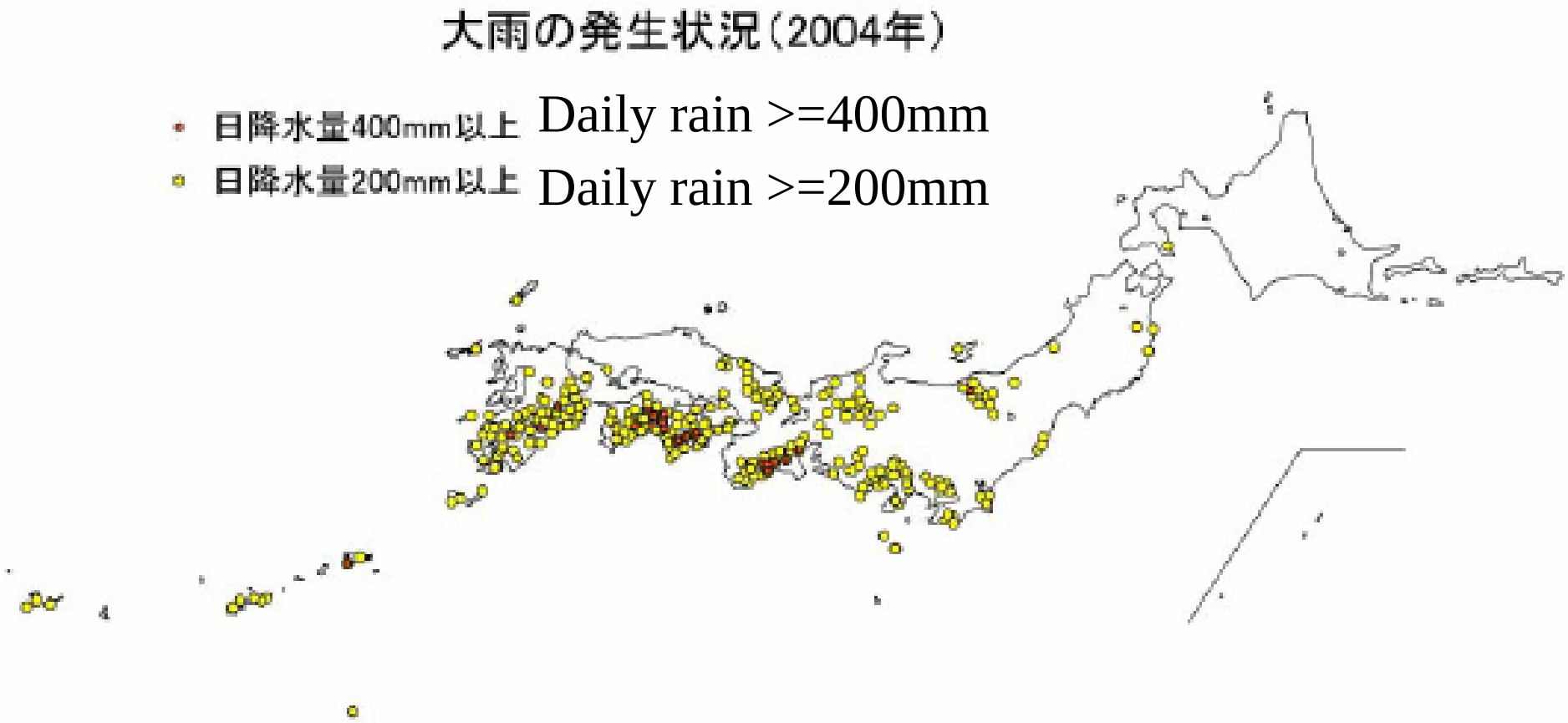
（注）地震、火山噴火による被害を除いた数値である。

消防庁調　平成16年10月29日18:00現在

# Climate: the number of typhoons in 2004



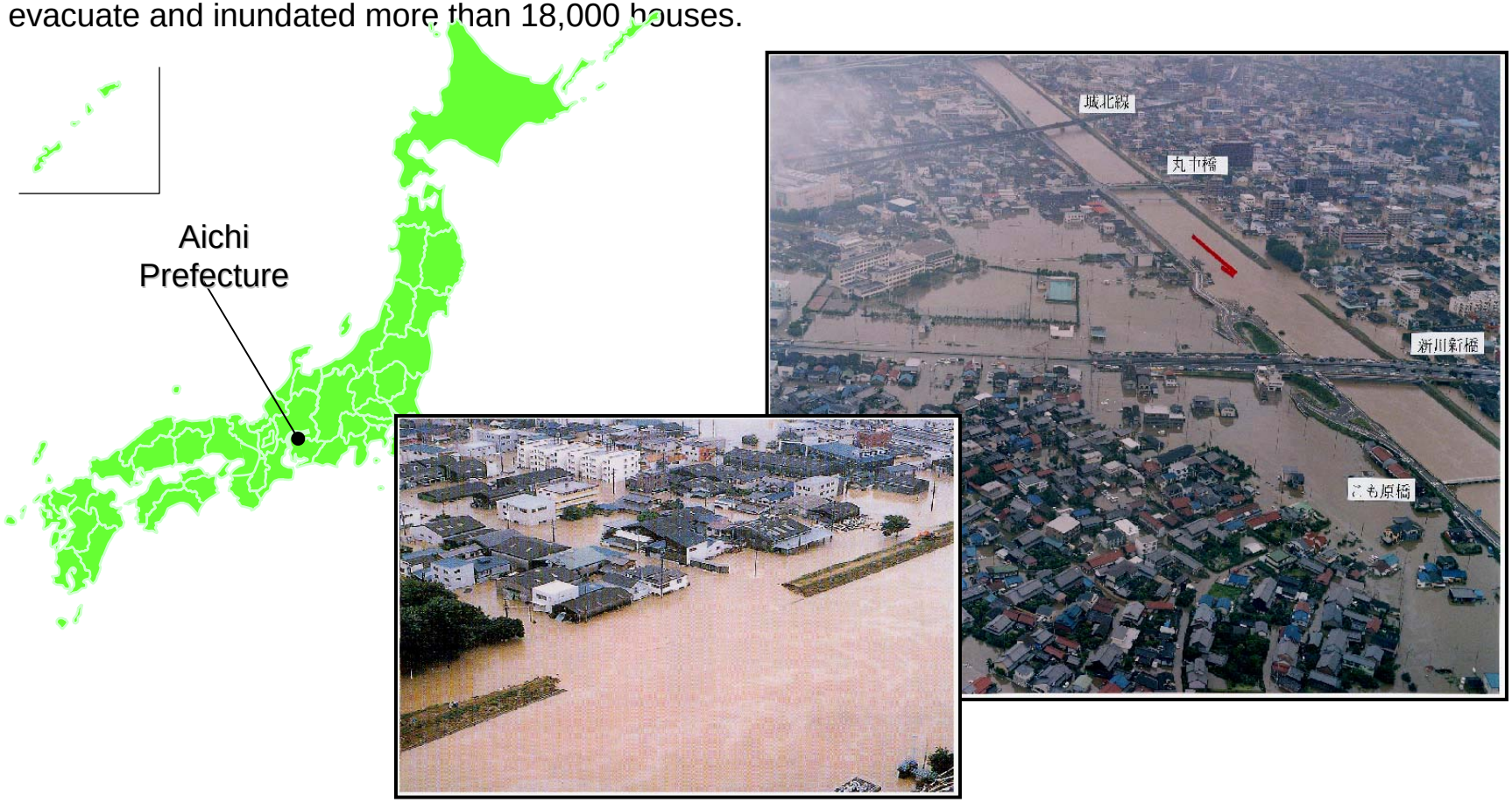
# Extreme rains in 2004




JMA, November 2004

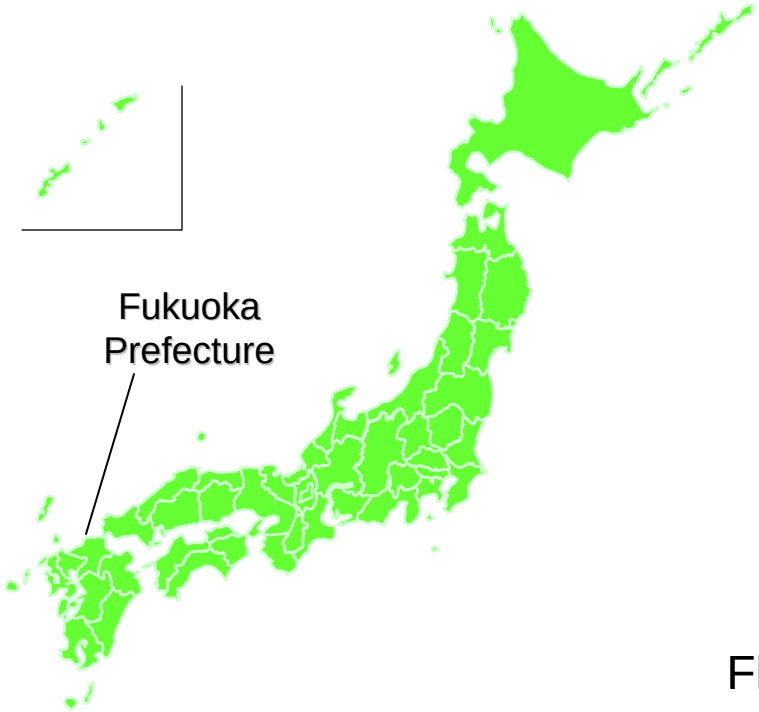
# Land use: Urban type flood damage that occurs frequently in recent years/Tokai Heavy Rain (Aichi Prefecture)

Occurrence of “urban type” flood damage that occurred in a city where assets concentrate.
On September 11th and before dawn of 12th, 2000, the levees breached in the Shonaigawa River & the Shingawa River that flow through the northern part of Nagoya City. This was caused by the regional intensive rainfall that hit the Tokai District. This flood forced about 30,000 residents to evacuate and inundated more than 18,000 houses.



# Urban type flood damage that occurs frequently in recent years/Fukuoka Flood Damage (Fukuoka Prefecture)

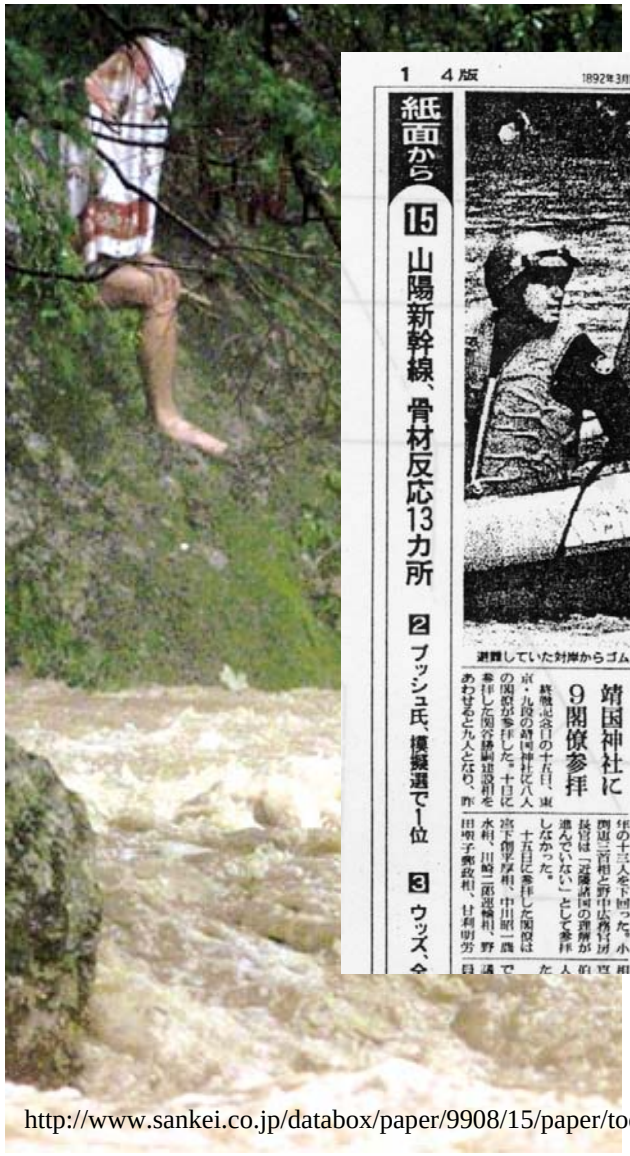
<Flood damage that hit the urban underground space>
Influenced by the seasonal rain front that became active in the midnight of June 28, 1999, warm and moist air flowed in from the southern seas, developing rain-bearing clouds and bringing about enormous damages to the northern part of Kyushu. As a result, the Mikasa River flowing through Fukuoka City overflowed and caused serious damages to the central areas of Fukuoka. Flood water flew into the basement which accompanied human deaths.





Flood water flowing into basement space by overtopping the sandbags

# People's perception: Kurokura flood accident in August 1999

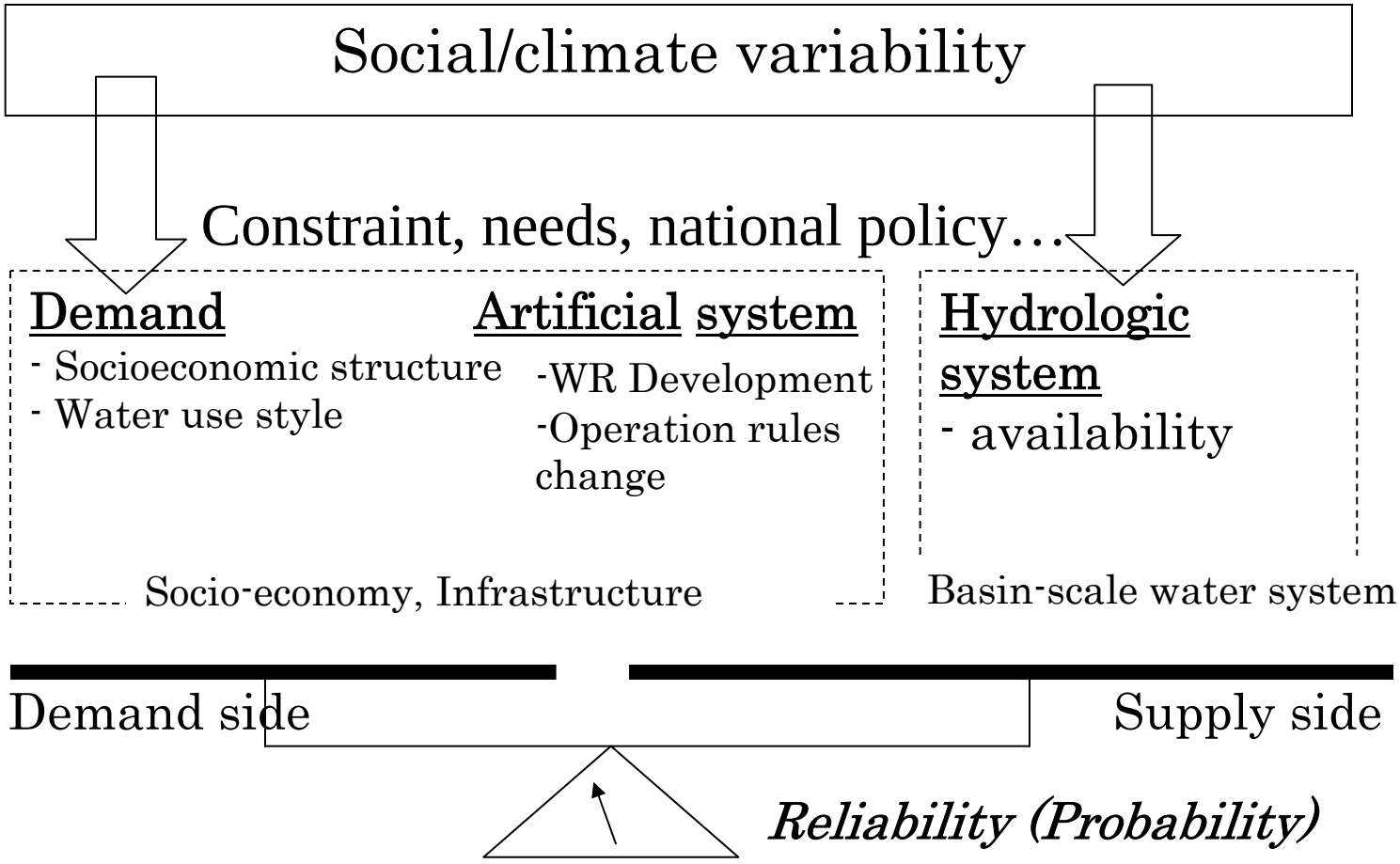



http://www.sankei.co.jp/databox/paper/9908/15/paper/today/itimen/15iti001.htm

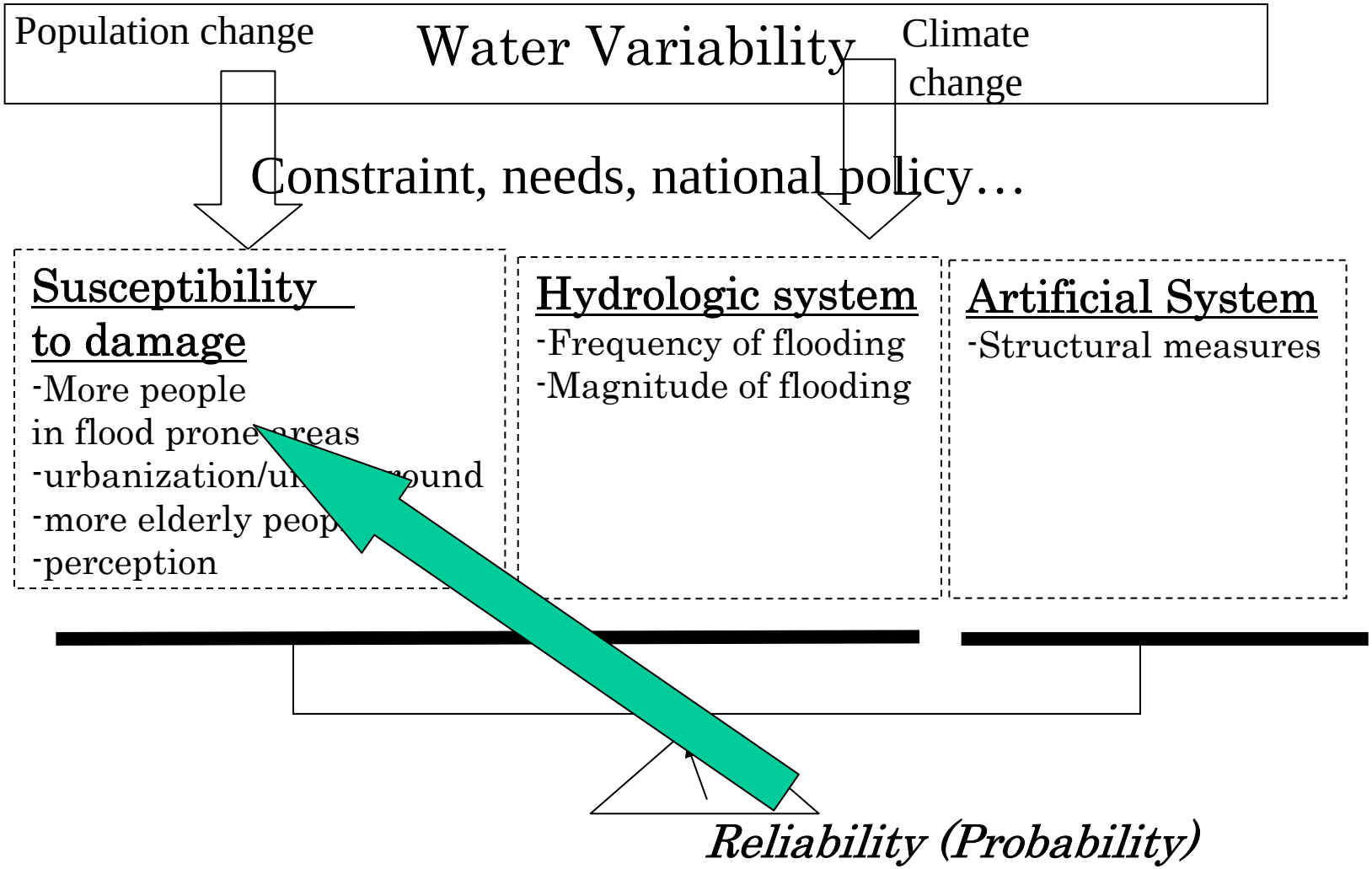
# Lessons learned from Kurokura accident?

- Some campers ignored pressing evacuation warning. (police, media)
- I thought it was the same flood as (small) one experienced before. (survivor)
- I never imagined the flow became that big. (survivor)
- I saw some were convinced by the camp leader insisting safety. (evacuated camper)

# Structure of Water Resources Issues

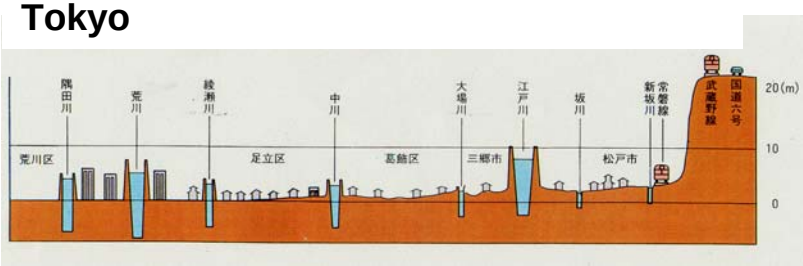


# Structure of current flood issues



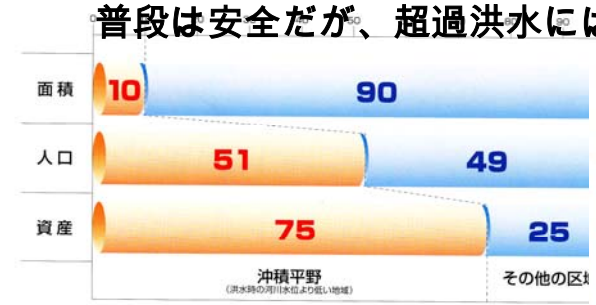
# Regional Difference

**Tokyo**




**氾濫源の資産を構造物で守る治水事業が必要**

**普段は安全だが、超過洪水には非常に脆弱**





The Tsurumi River (Kanagawa Prefecture)

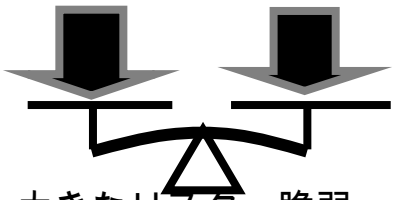
**脆弱性を緩和する施策例：スーパー堤防**


**London**

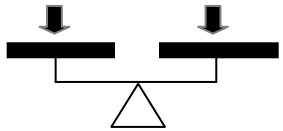

氾濫源の土地利用規制が容易

ソフト対策が有効に機能

**Regional Difference**



大きなリスク・脆弱性と大きな対策でバランス



小さなリスク・脆弱性と小さな対策でバランス

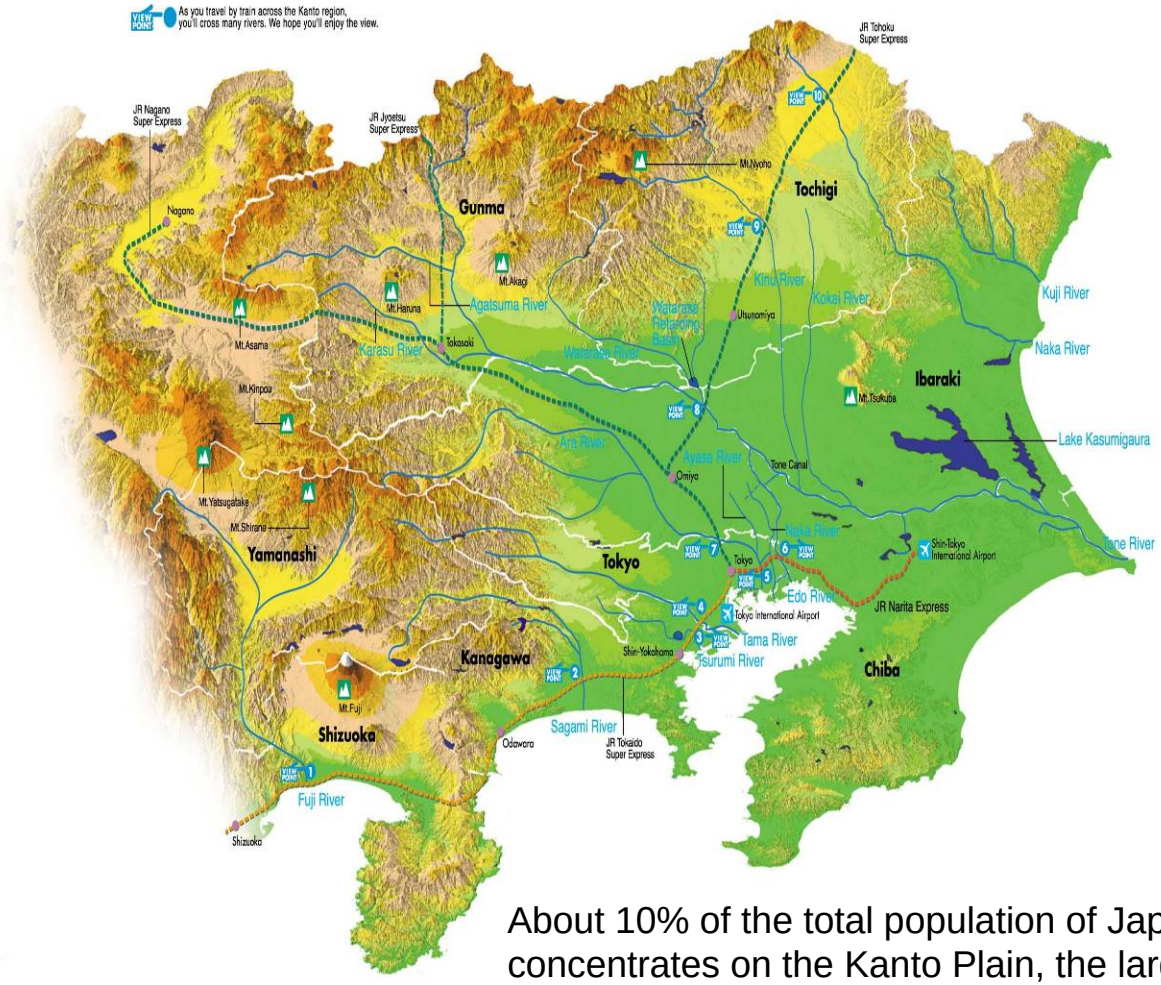
日本の洪水施策評価には、欧米では無視しえる面を含めた評価が不可欠

# Issues

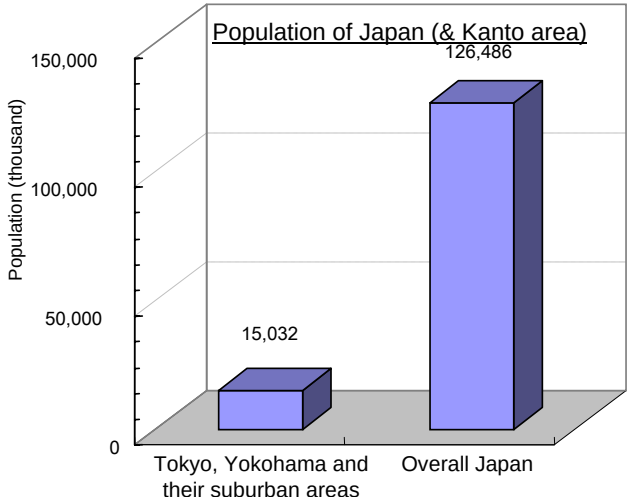
- Monitor change in susceptibility of society
- Understand interrelations between elements including people’s perception

# Typical geomorphology and land-use of Japan

**Major cities have been built on alluvial flood plains.**





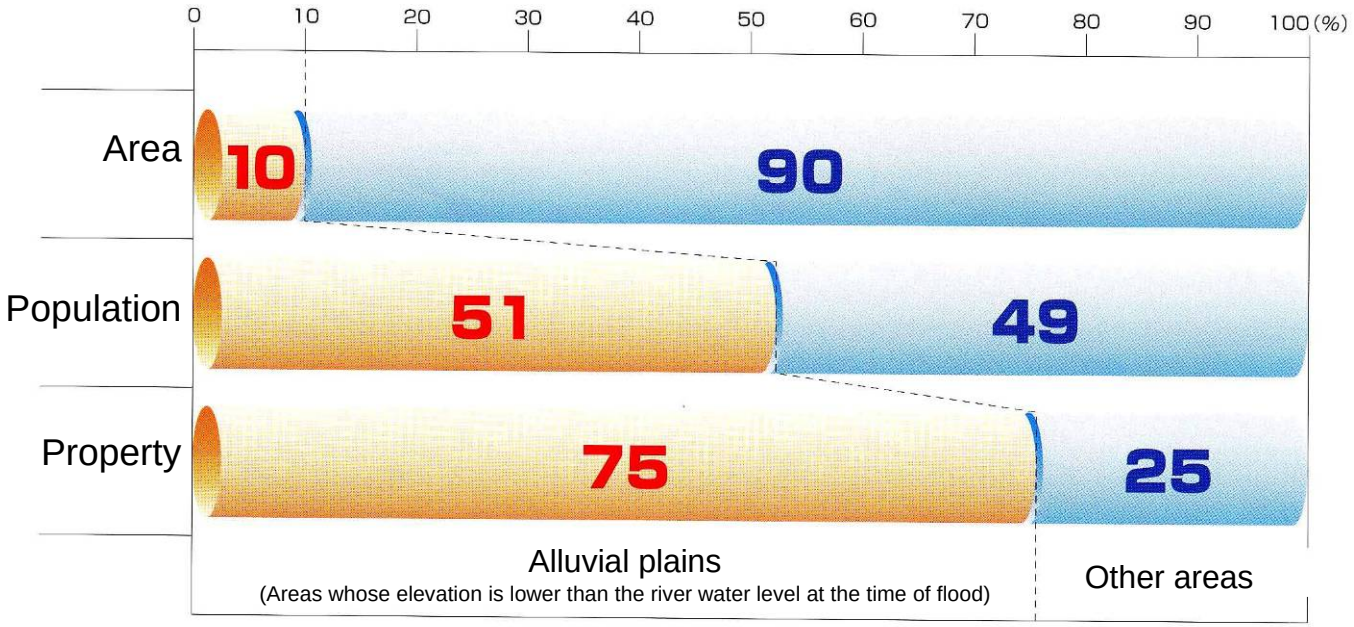



About 10% of the total population of Japan concentrates on the Kanto Plain, the largest plain in Japan.

Source: "World Factbook 2000/2001" (published in Japan)

# Property that concentrates on plains

Japan has many mountain ranges, and thus plains account for only about 10% of its total land area.
About 50% of the total population and 75% of property concentrate on the plains.




Japan has many mountain ranges, and about 50% of the total population and 75% of property concentrate on the plains that account for only about 10% of its total land area. Damages caused by floods, therefore, could be much more serious than those in other countries.

# Congestion in the residential and commercial/industrial areas

Due to insufficient areas suitable to reside in Japan, along the river courses exist highly congested commercial/industrial and residential areas.
The similar land-use can be seen in Asian countries that have been developing remarkably in recent years.

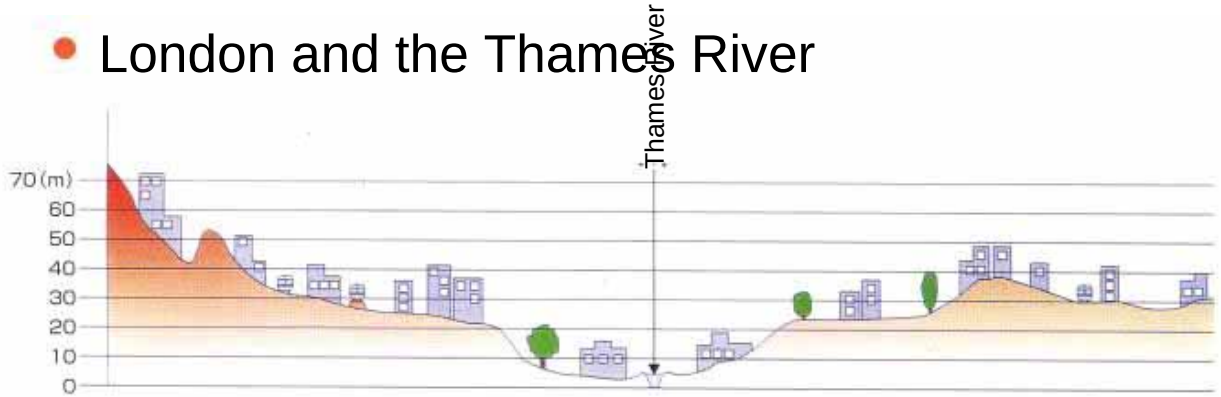
Yokohama City, located in the Tsurumi river basin.


Makati, Metro Manila, located in the Pasig river basin, the Philippines

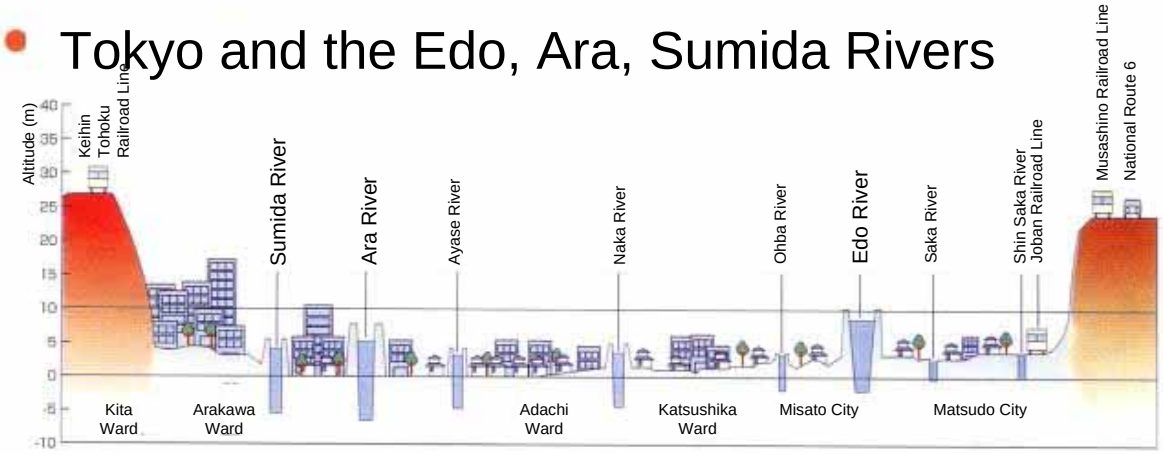
# Features of rivers flowing in plains

There are many raised bed rivers in Japan because of much sediment discharge caused by slope collapse in the upper mountainous areas. This causes sever damages in case of levee breach. Historically, therefore, flood control have been Implemented mainly by embankment.

- London and the Thames River




- Tokyo and the Edo, Ara, Sumida Rivers



# More fundamental purpose of flood control : Reclamation of uninhabitable lands

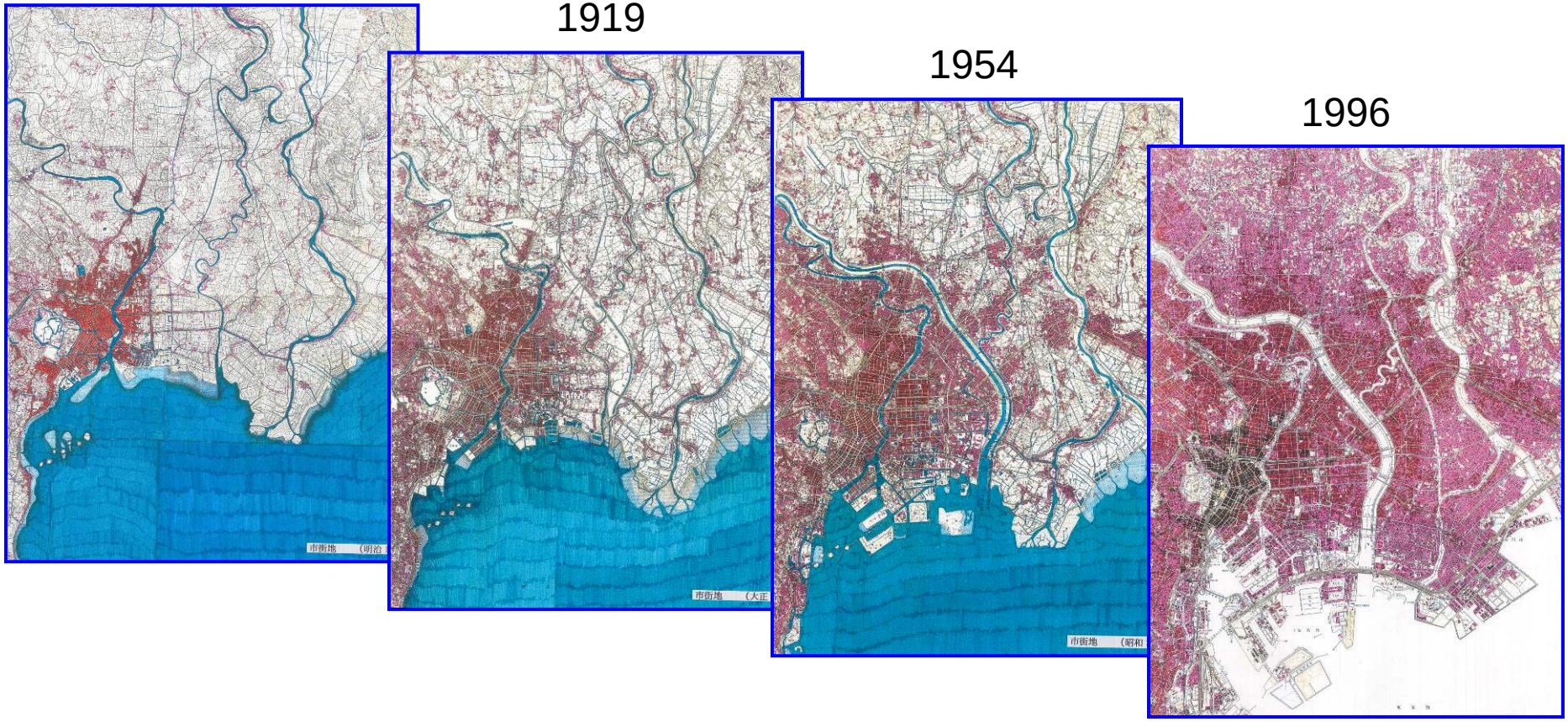
Flood control measures have been taken because of the concentration of population and assets in plains.  In the center of Tokyo, flood control projects such as the Arakawa Floodway have contributed to creation of residential areas and commercial/industrial areas, thus promoting economic development.

1882

1919

1954

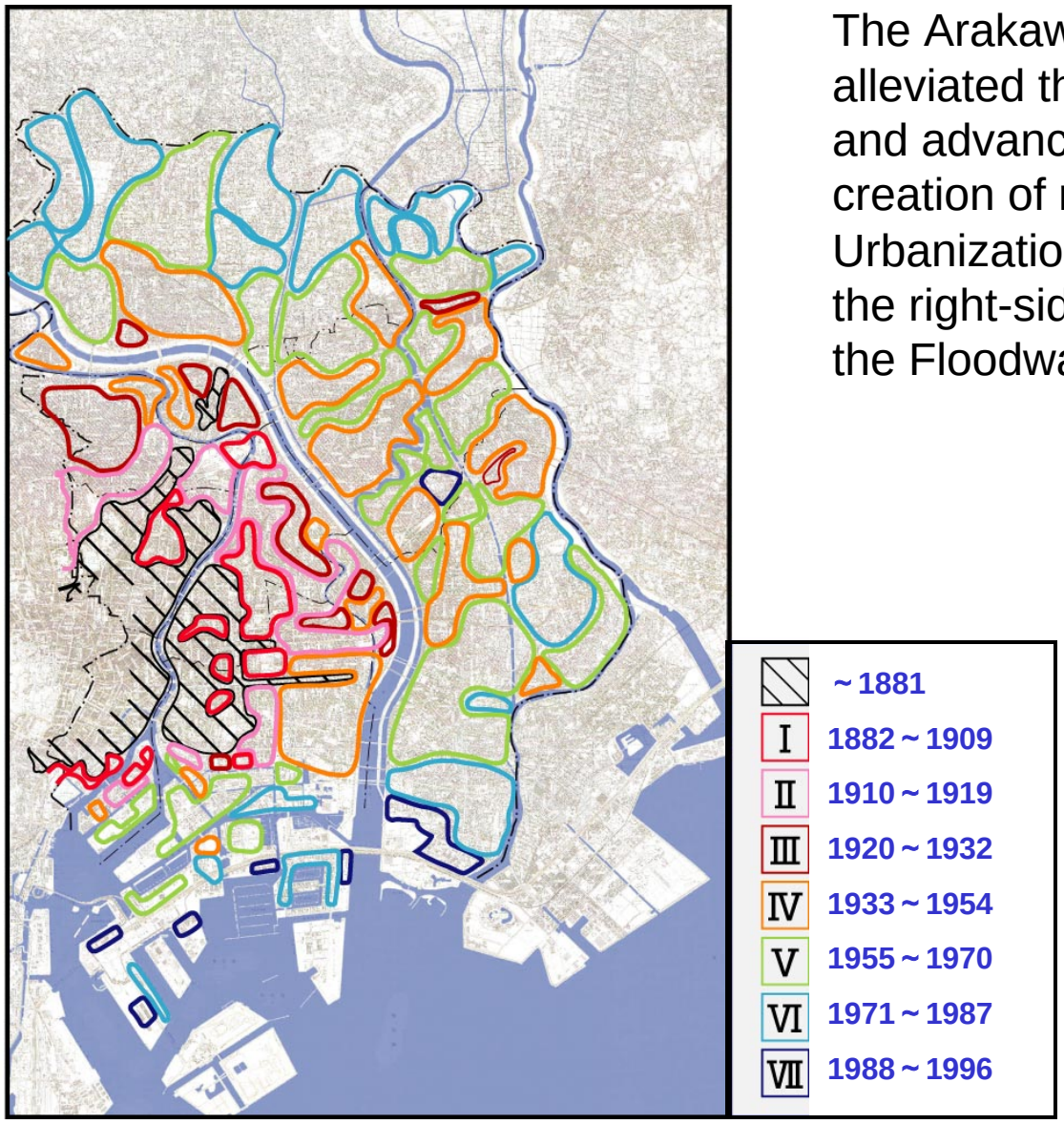
1996



# Establishment of urban foundations by means of flood control

Urbanization has been promoted by projects in the river mouth area in Makasaar City (Indonesia).


# Transition of urbanization in Tokyo driven by Arakawa Floodway (completed in 1930)

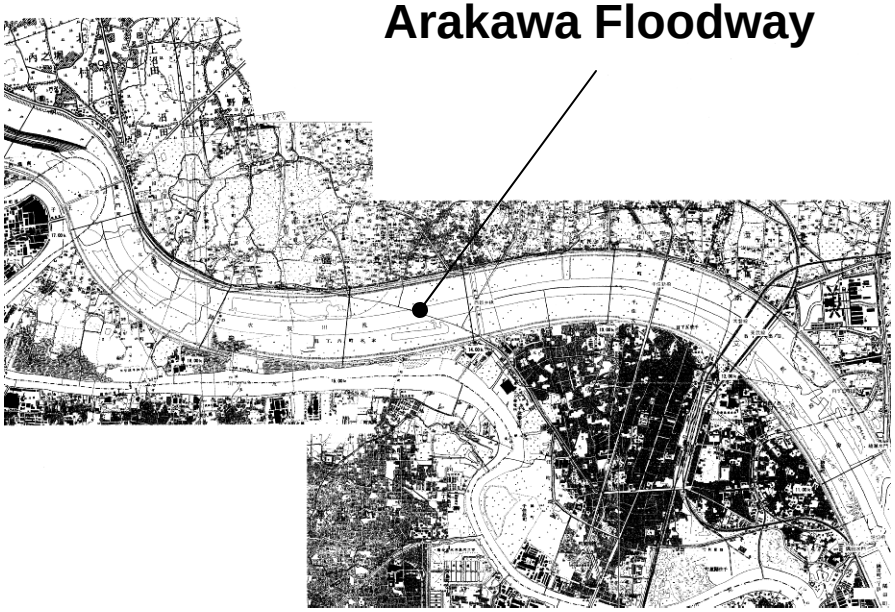



The Arakawa Floodway has alleviated the flood damages, and advanced urbanization with creation of residential areas. Urbanization has expanded from the right-side to the left-side of the Floodway.

# Urbanization Driven by Flood Control Works

〈１９１６〉

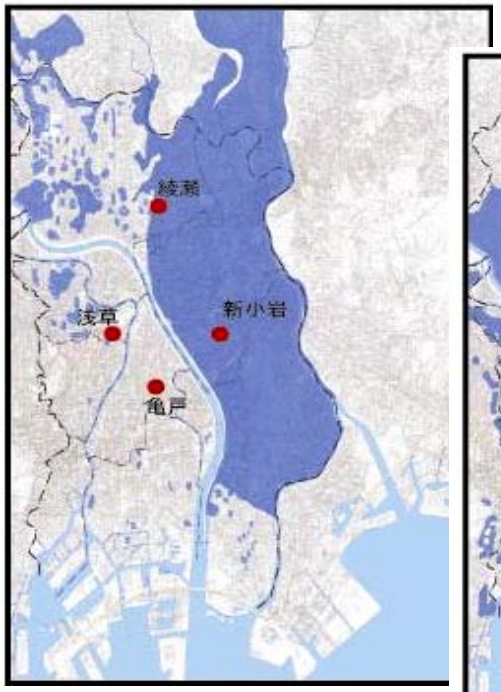
〈１９３０〉




**Vicinity of Kitasenju Sta.,**
**Adachi-ku, Tokyo Japan**

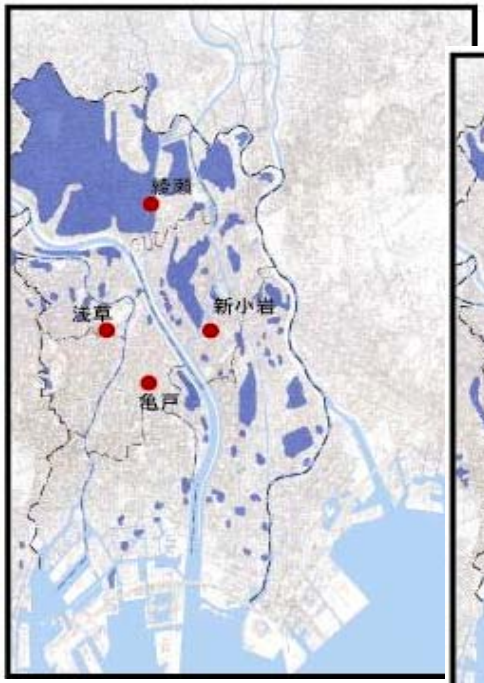
# Decrease in flooded areas in Tokyo

After the Kanogawa Typhoon in 1958, flood control projects have further been pursued, and as a result, flooded areas have decreased since the mid-1960s.

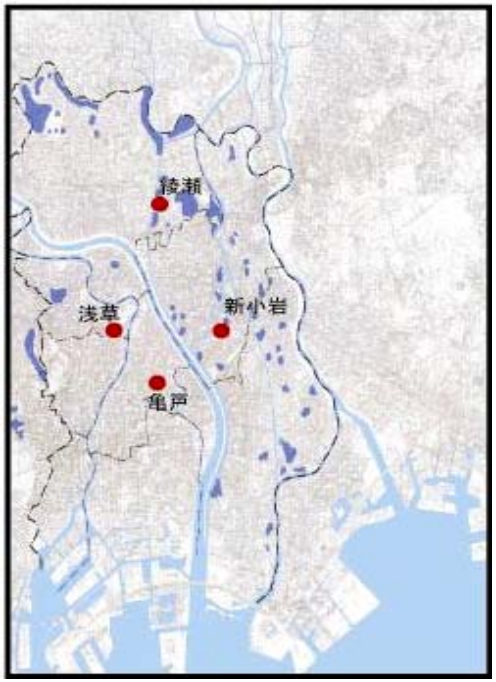



September 8, 1947
<Catherine Typhoon>
Total rainfall: 166.8 mm


1958
<Kanogawa Typhoon>
Total rainfall: 444.1 mm



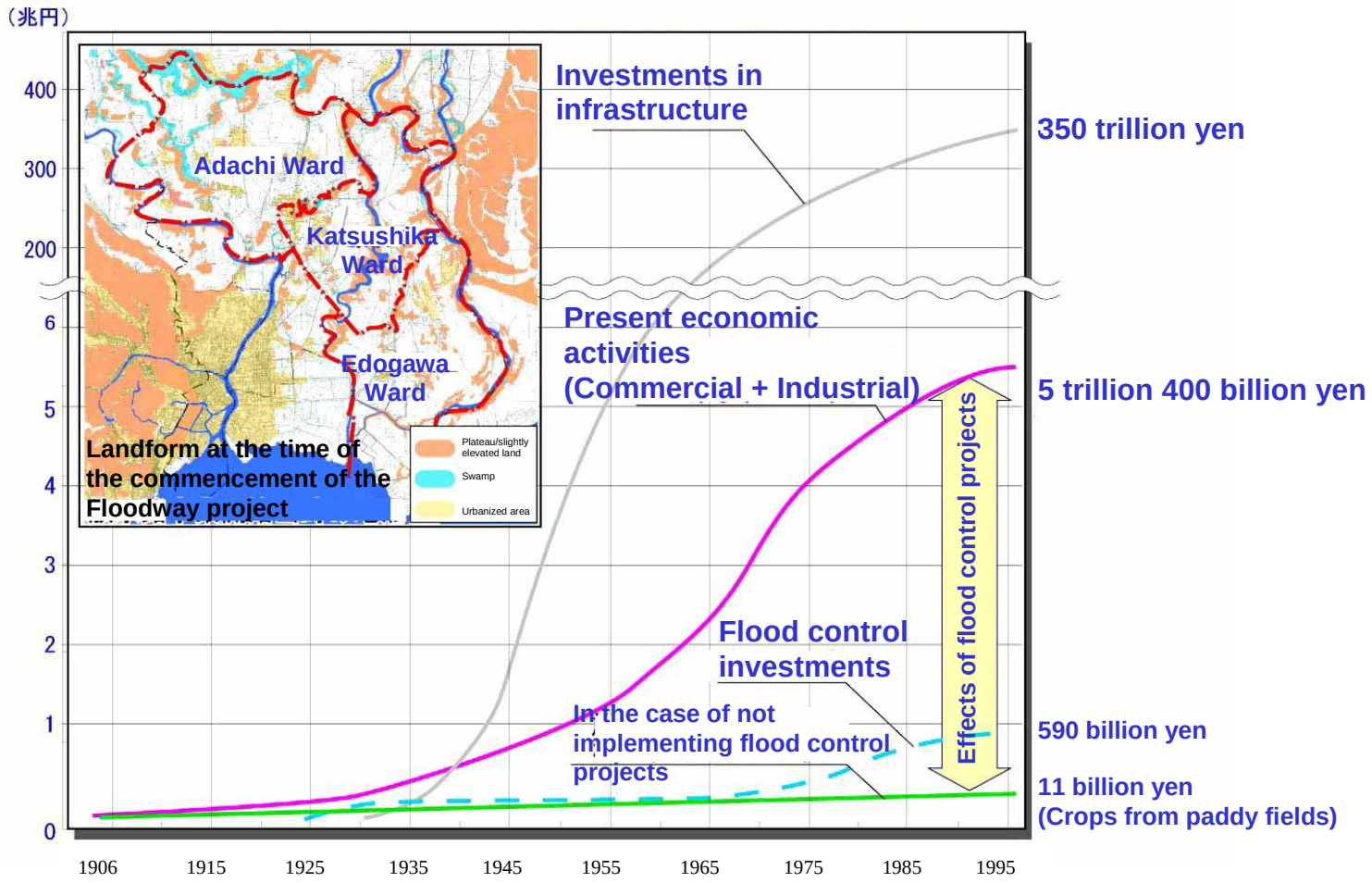

June 1966
<Typhoon No. 4>
Total rainfall: 235.0 mm




September 1982
<Typhoon No. 18>
Total rainfall: 313.0 mm

# Economic growth driven by flood control projects

Urbanized areas created by flood control projects (= economic growth) have come to require higher safety (= flood control projects).

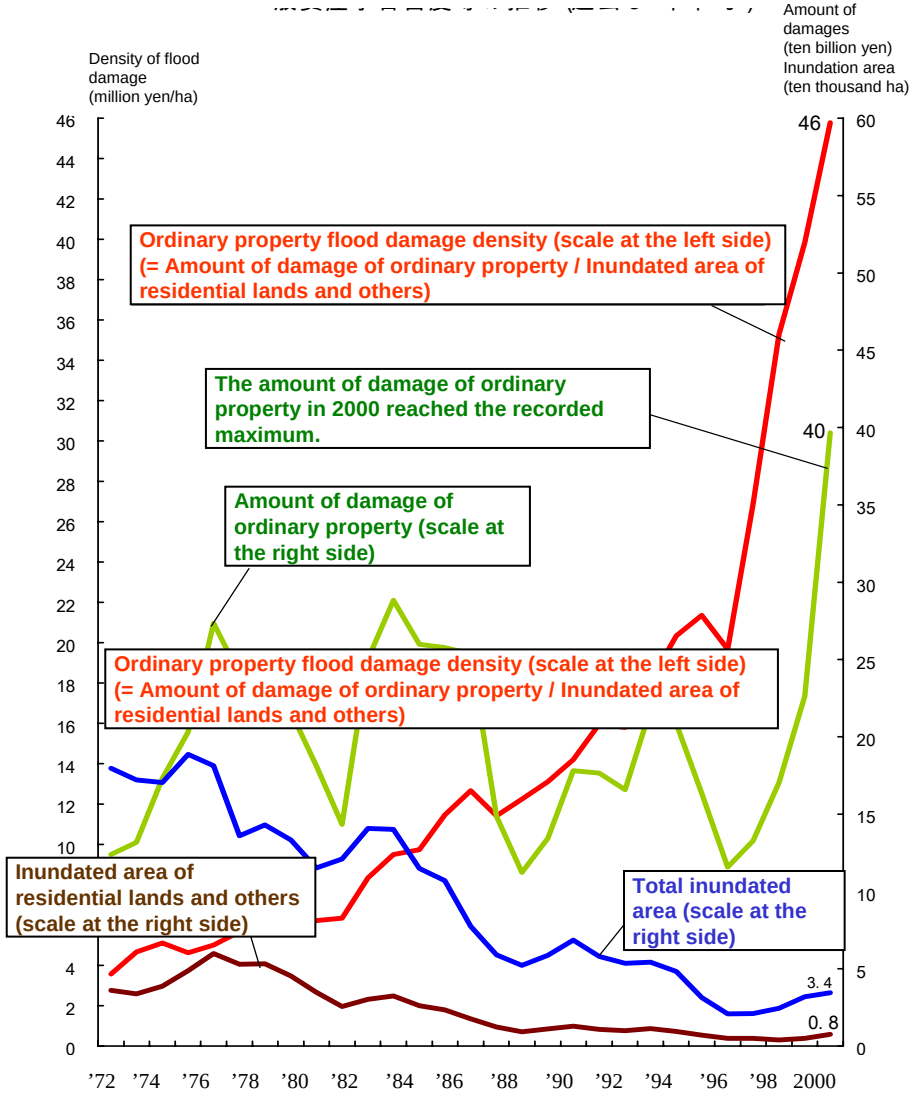


## Development of the Tsurumi River Basin (Kawasaki City, Kanagawa Prefecture): 1960s –

The Tsurumi River basin has been rapidly urbanized since 1960s, when flood control measures began to lag behind urbanization.

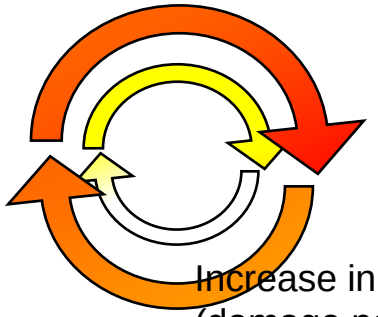
The Tsurumi River (Kanagawa Prefecture)

# Increasing flood damages




Flood control projects have created urbanized areas and brought about economic growth. Nowadays, however, flood risk areas have been also urbanized, and increased such risks as would cause severer damages once flooding occurs.

Urbanization = Economic development
Higher safety against flooding is required.

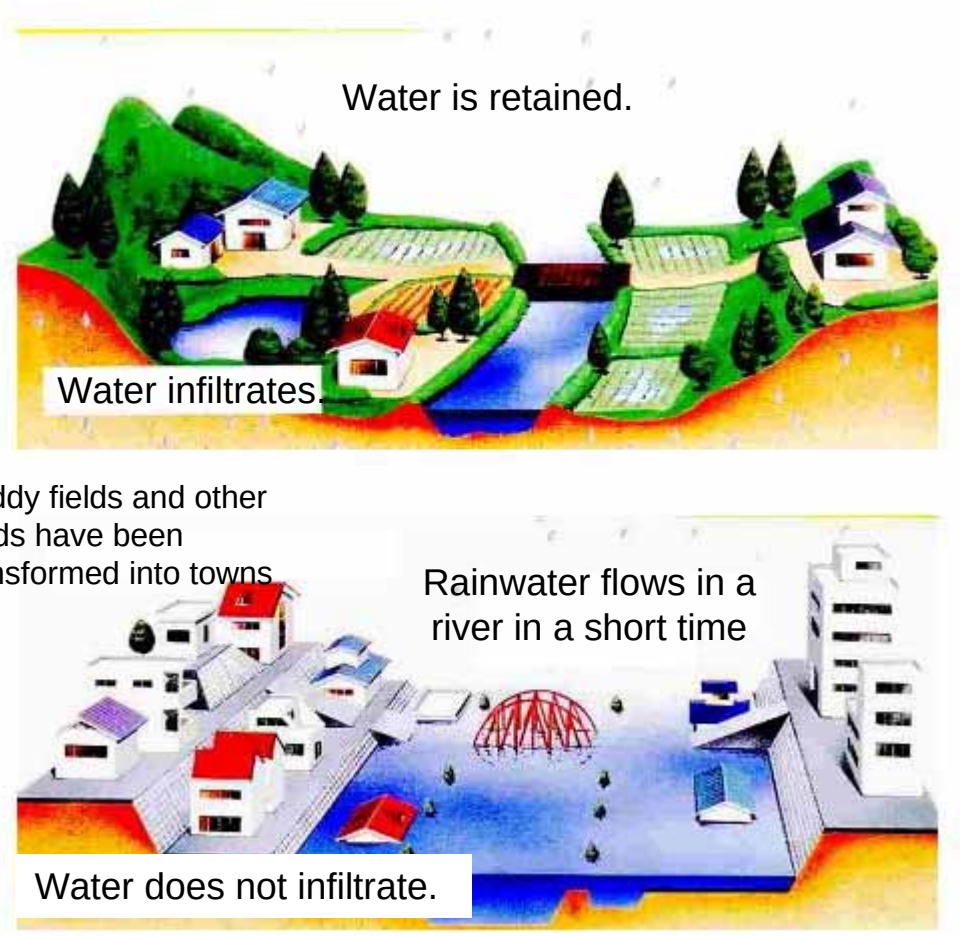


Increase in property (damage potential)

Improvement of safety level against flooding
Urbanization = It brings about economic development

# Change in flood runoff

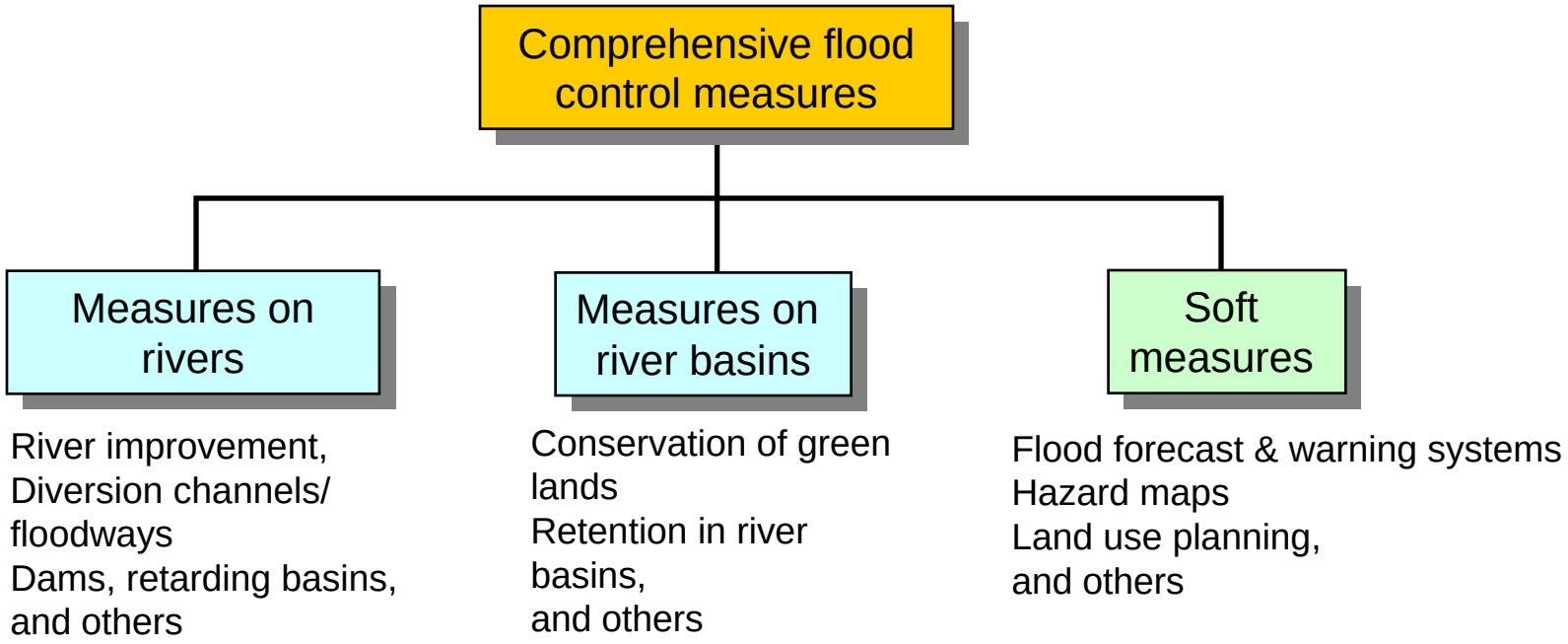
Rapid urbanization increased the amount of rainfall that directly flows into a river, and flooding became more likely to occur.




* HP of the River Division of Aichi Prefectural Government

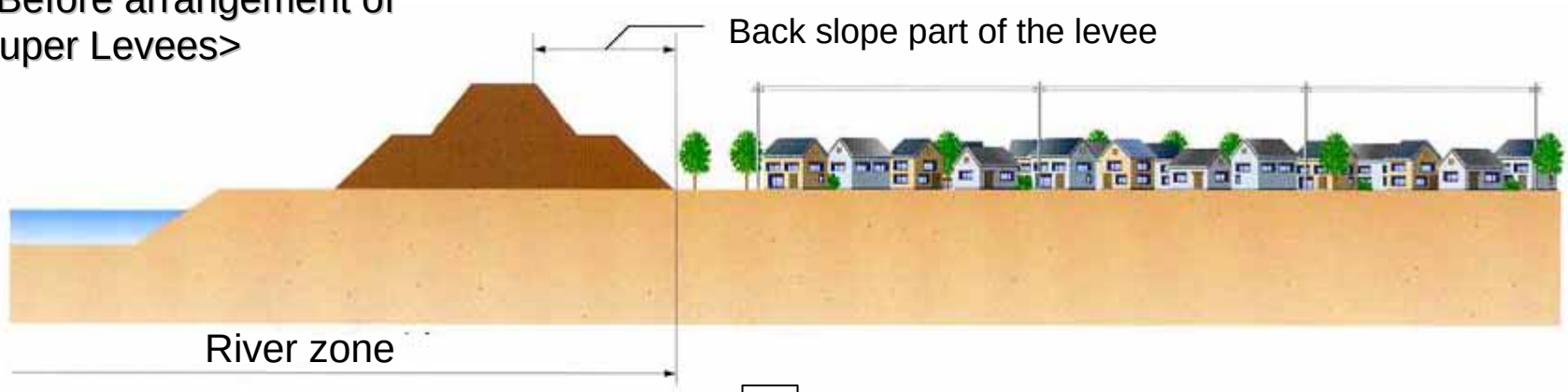
# Flood control in the future

In considerably developed urban areas, the social situation and economic constraints in the river basin disabled the sufficient implementation of conventional river improvement works. Therefore, flood control measures combined with those designed for a whole river basin and software measures, so-called Comprehensive Flood Control Measures, are required.

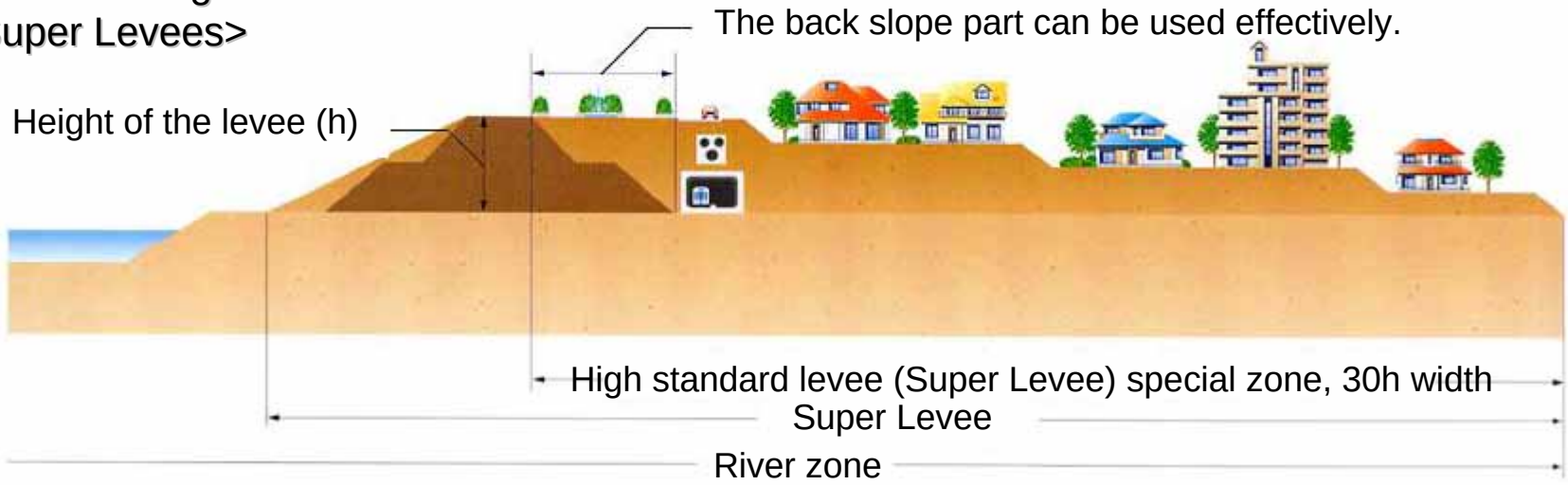


# Flood control facilities (measures on rivers)

<Before arrangement of Super Levees>

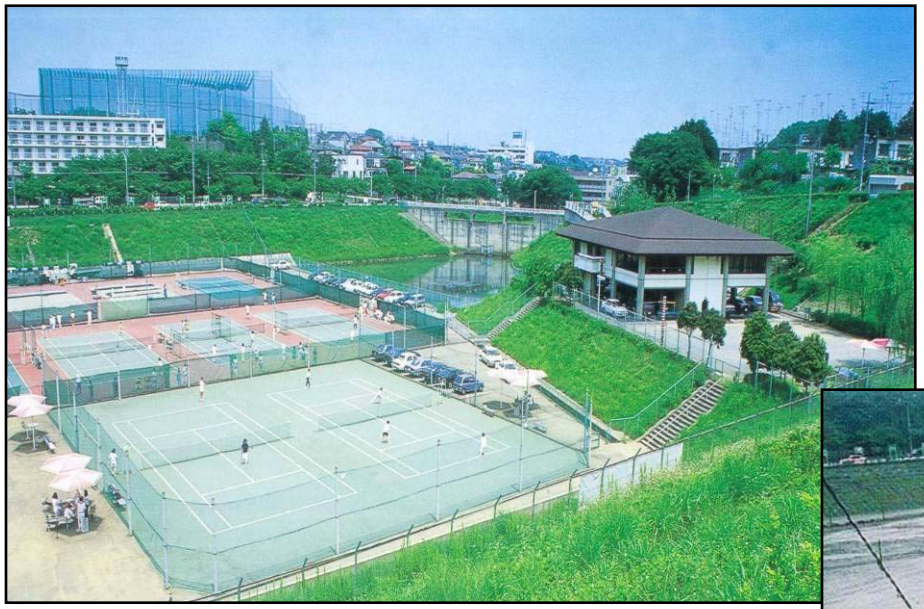



<After arrangement of Super Levees>



# Runoff control facilities (measures on river basins)

<In normal times>



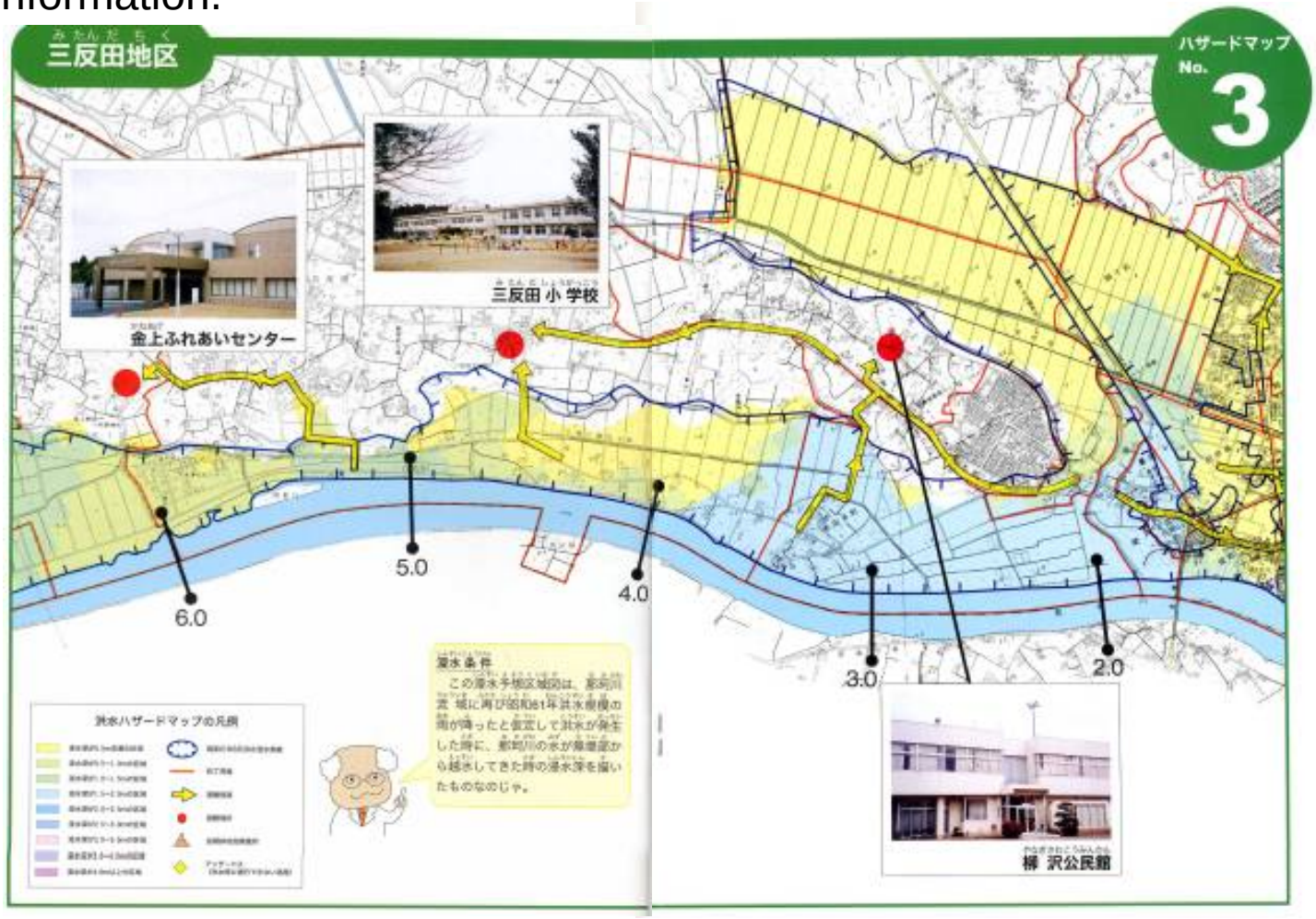
Kirigaoka regulating pond in the Tsurumi river basin (Kanagawa Prefecture)

The tennis courts in normal times, are used as a regulating pond at the time of flood to decrease the load of discharge to the river channel.

<At the time of flood>

# Sharing flood risk information (software measures)

Human damages can be alleviated by raising awareness of residents in the river basin about the flood risks through disseminating flood risk information.




* Flood hazard map along the Naka River

# Conclusion(1)

- Structural flood control measures have laid the ground for economic growth in Japan.

- Because of lack of appropriate land use management, river basins has rapidly developed, and property has concentrated in the urban areas. Further investment on flood control was required to protect the urban areas from flood damages.

- Congested land use hampered implementing the measures on rivers (levees and retarding basins), thus giving rise to the needs of new flood control measures (= comprehensive flood control).

## Conclusion(2)

- Flood control investment efficiency should have been maximized by combining structural and non-structural measures more organically.

- Japan's experience of comprehensive flood control measures may give guidance to other countries, in case that only the measures on rivers do not function well to alleviate flood damage.