Flood Management in Japan

1. Vulnerable land for flood disasters
2. Change of socio-economic conditions
3. Change of natural conditions
4. New concept of flood management

December 2, 2007

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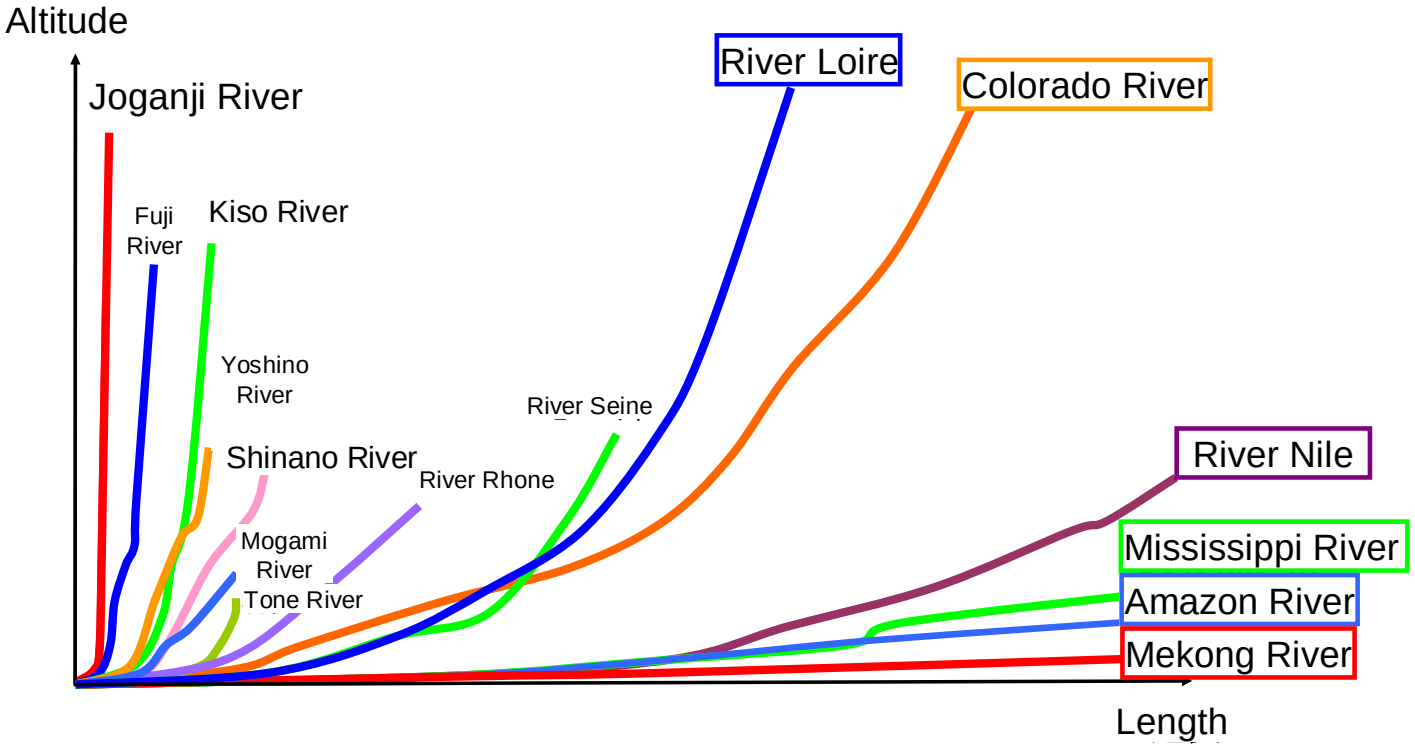
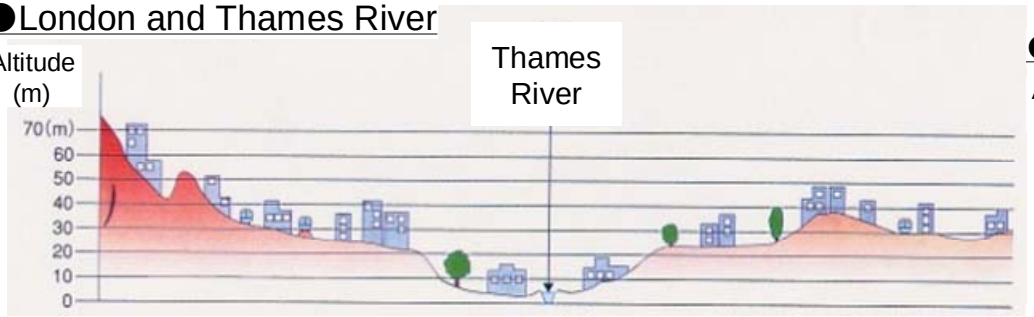
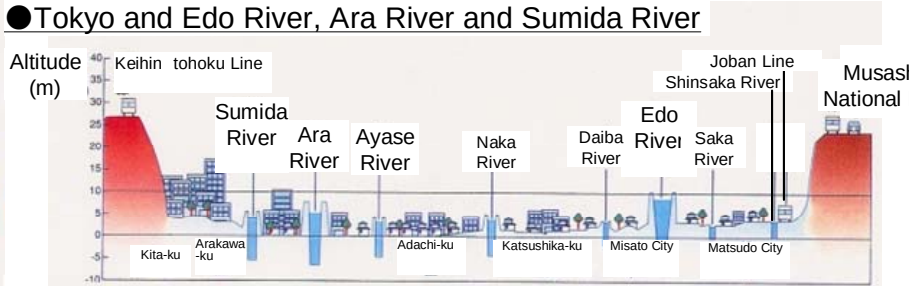
Characteristics of rivers in Japan



●London and Thames River



●Tokyo and Edo River, Ara River and Sumida River



Most rivers in Japan are steep with short distance from the source to the sea, resulting in rapid flow. Furthermore, most of urban areas are located in low-lying areas below high water level.

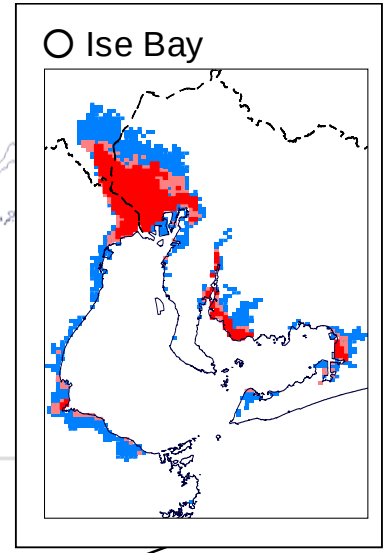
Major cities are located in low lying areas

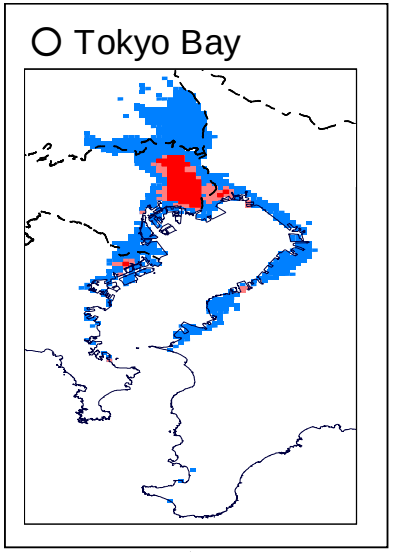
Areas and population of Zero-meter regions

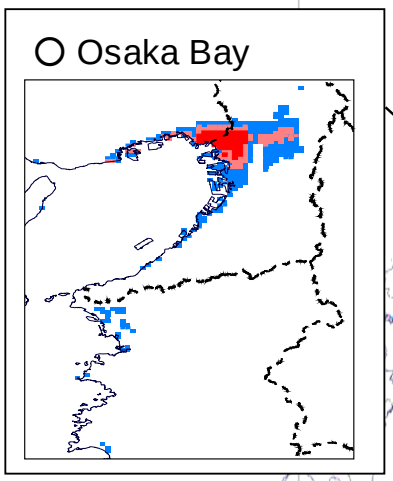
	National total	Three major harbors total	Tokyo Bay	Ise Bay	Osaka Bay
Area (km2)	1,648	576	116	336	124
Population (million)	539	404	176	90	138

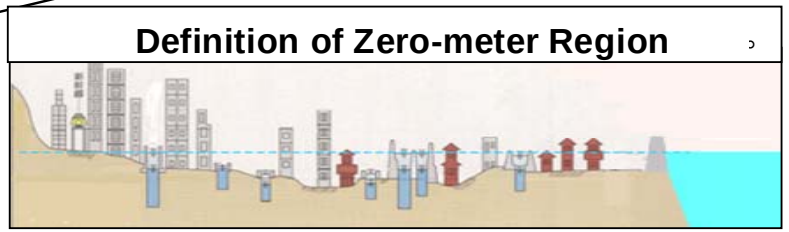
So called Zero-meter regions

- :T.P. ±0 m or lower
- :Lower than average syzygetic high tide levels
- :Lower than anticipated high tide levels



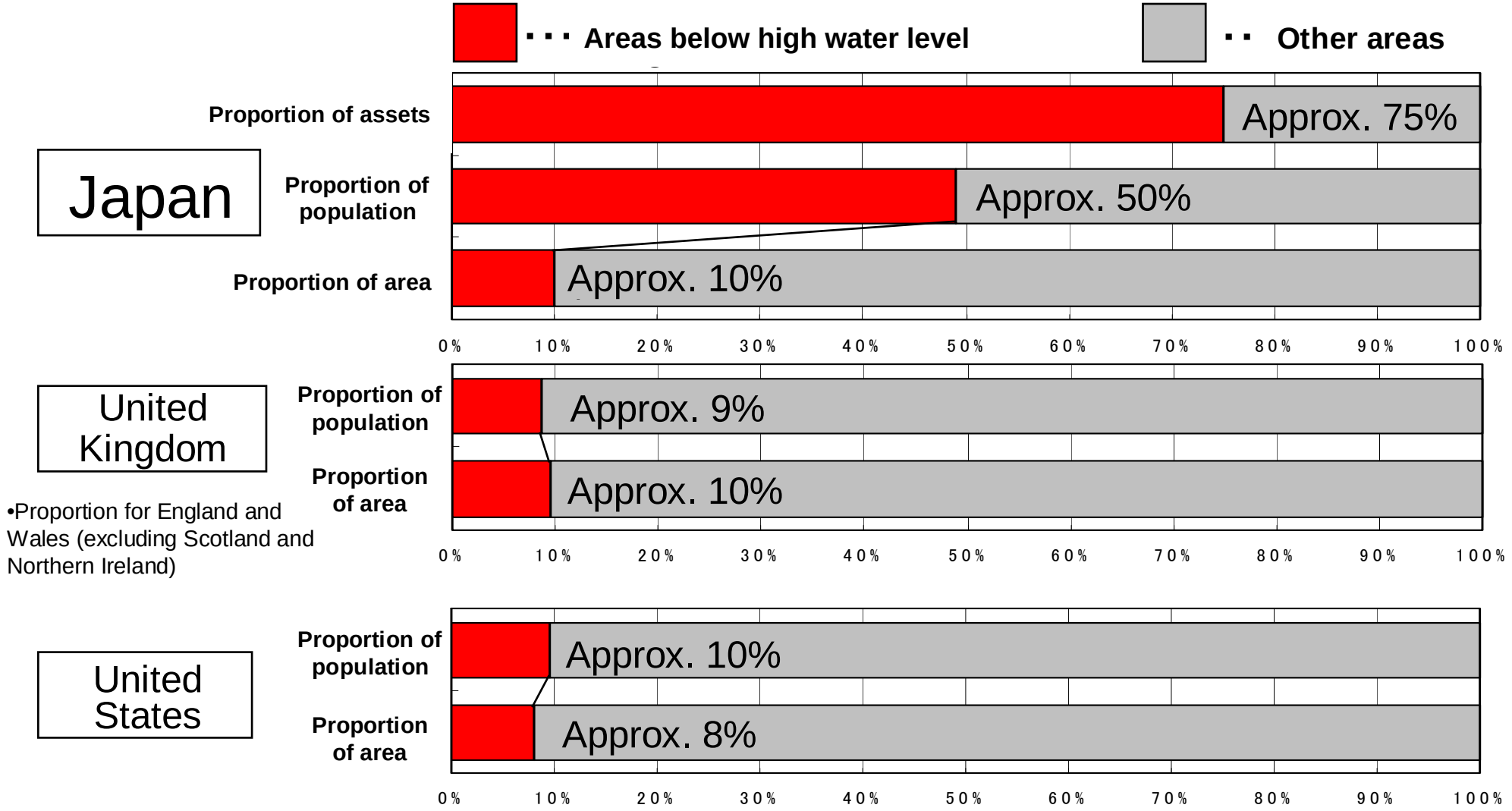






Population and city functions are concentrated in areas below sea level in coastal areas of three major bays. Catastrophic disasters would occurr in case of bank failure.

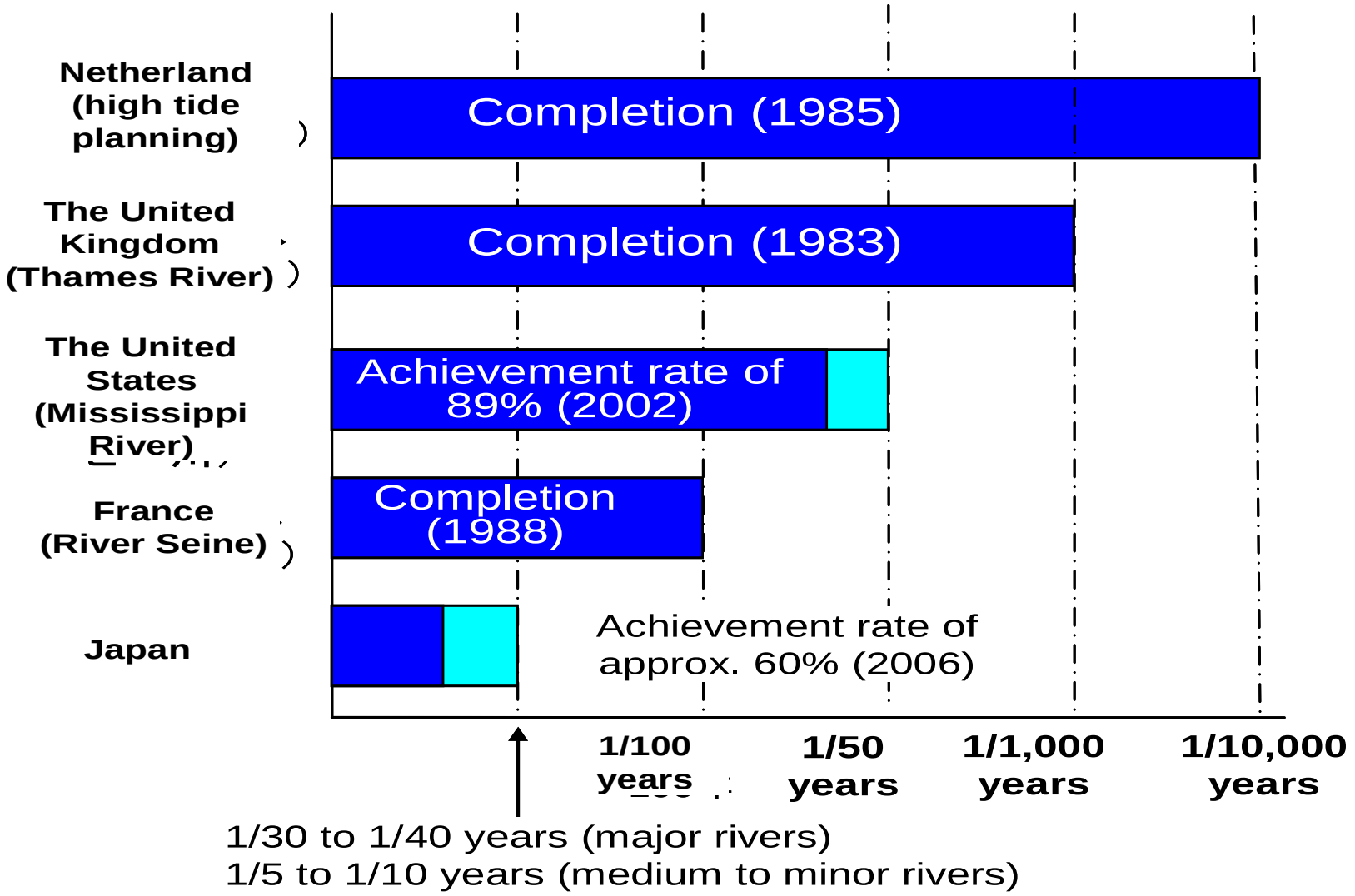
Population and assets are concentrated in flood prove areas



•Proportion for England and Wales (excluding Scotland and Northern Ireland)

Approximately half of the population and three-quarters of total assets are concentrated in low-lying areas.
Huge damage would be caused in case of flooding.

Lower safety level for flood disasters



Compared with other industrialized nations, safety level of national land protected by flood control facilities is lower in Japan.

Urbanization in Tsurumi River basin

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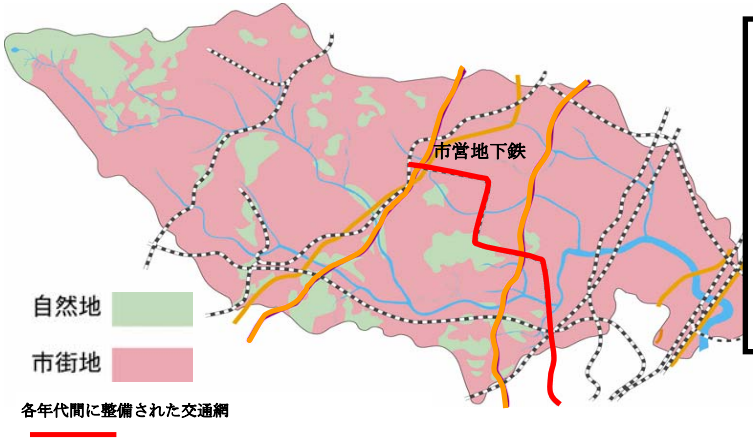
Urbanization rate：
About10%

Population：
About 450,000



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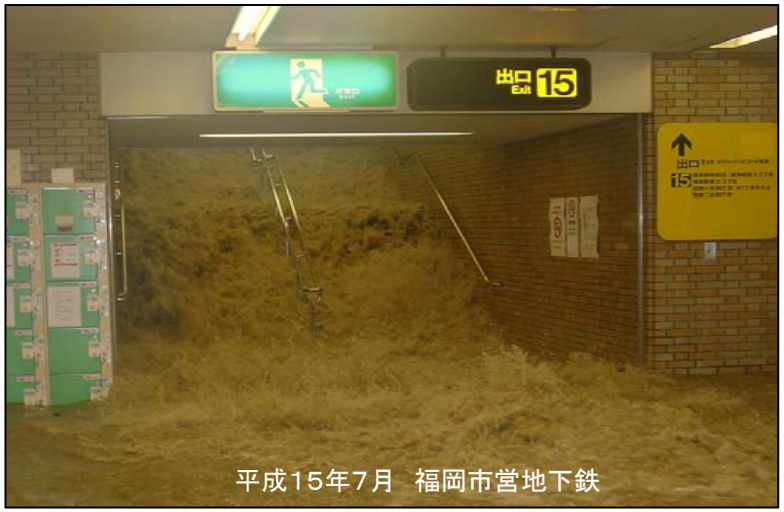
Urbanization rate：
About 85%

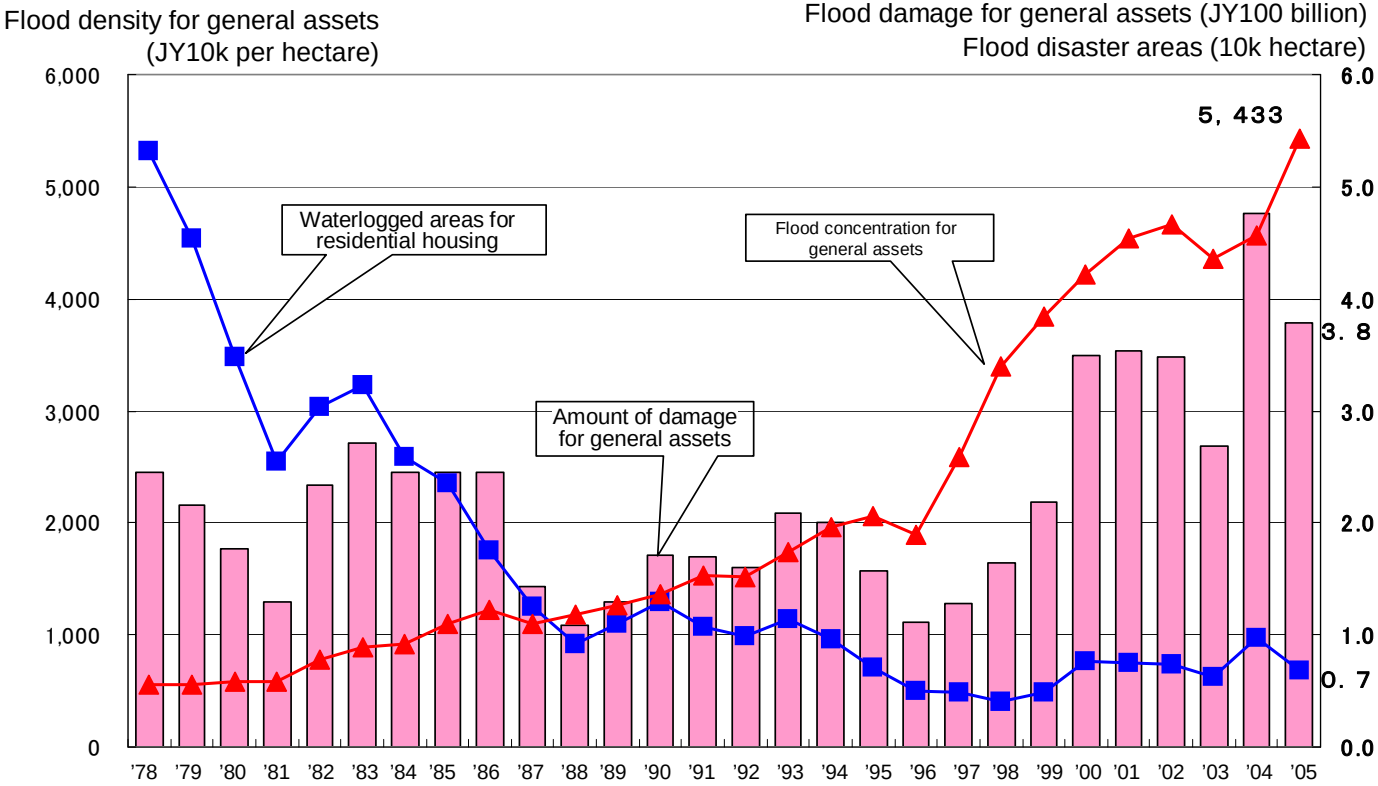
Population：
About 1.88million

Occurrence of widespread submergence at the underground facilities in urban areas



Progress of urbanization in flood prone area causes increase of flood risk and also causes new type of disasters, such as inundation of underground facilities.

Increasing flood risk due to changes of social conditions 2



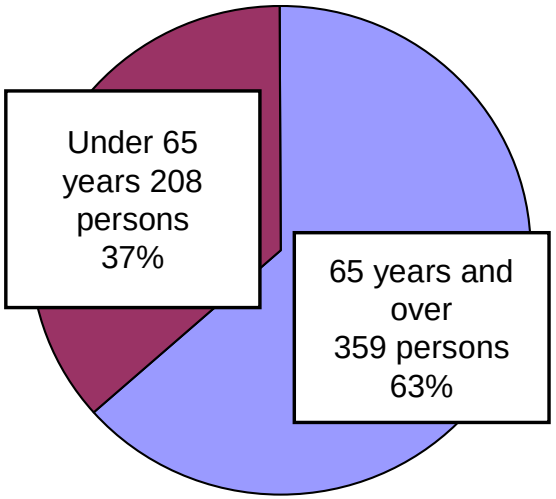
(1) Amount of damage (JY10k)/waterlogged areas (hectare) (costs as of 2000)
(2) Figures represent average for past five years.
(3) Non-operation losses for businesses are included in the amount of damage for general assets, as well as the concentration of waterlogged areas.
(4) Figures were derived from “Flood Statistics” issued by the River Bureau of the Ministry of Land, Infrastructure and Transport.

Electronic equipments, once submerged in water, are no longer usable.

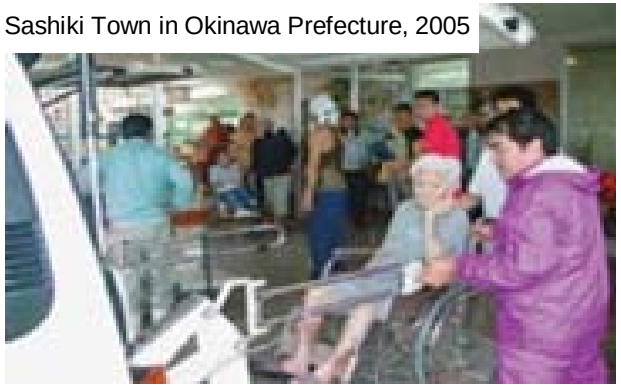
September, 2000
Heavy rain in Tokai region

Although the flooded areas are definitely decreasing due to flood control projects having been carried out over many years, the amount of economic losses in flooded areas has sharply increased due to increasing number of assets vulnerable to flooding.

Proportion of elderly among disaster victims



Sashiki Town in Okinawa Prefecture, 2005



The slope behind a nursing facility collapsed in Sashiki Town, Okinawa Prefecture, in June 2005 due to the heavy rainfall, resulting in the evacuation of all 70 people in the facility.

ヘリ救助 震える園児

新潟 豪雨

濁流、一気に堤防破壊

「津波のようだった」

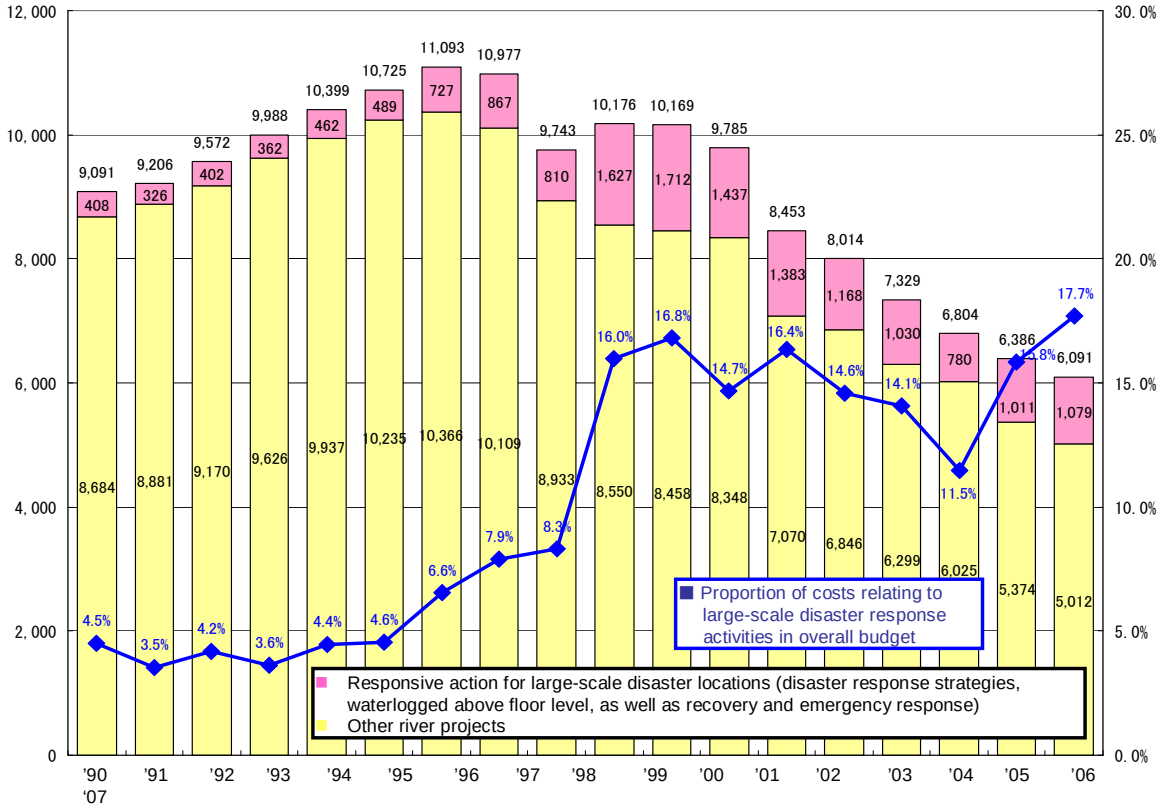
77 kindergarteners were trapped in school facilities by flooded water in Niigata.

Asahi Shimbun on July 14, 2004

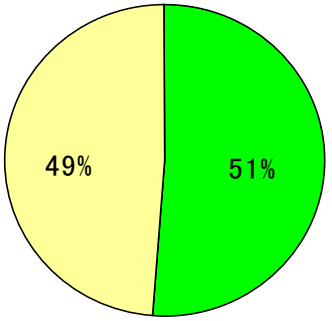
Due to the aging population, a significant number of victims were among those who required assistance in case of disasters, such as the elderly or children in day care facilities.

Increasing budget for post disaster responses

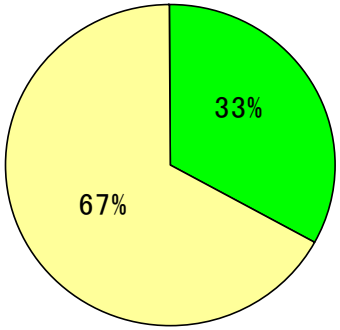
Increasing budget for post disaster responses



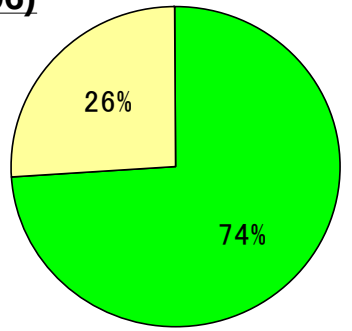
More than half of the budget for river projects is for post-disaster responses



■ River projects budget (FY2006)



■ Directly managed river projects (FY2006)

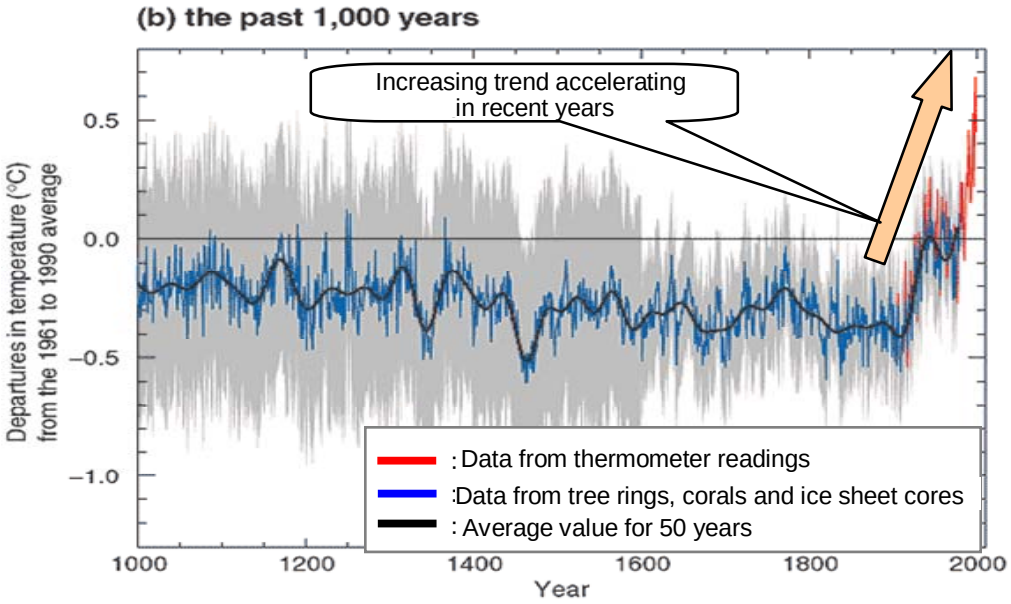


■ Auxiliary river projects (FY2006)

Proportion in total budget increased for post disaster measures such as recovery works for locations afflicted by large-scale disasters, due to increased occurrence of floods in recent years. It is not possible to invest necessary amount to preventative measures, which is also due to reduction in total amount of budget for flood management.

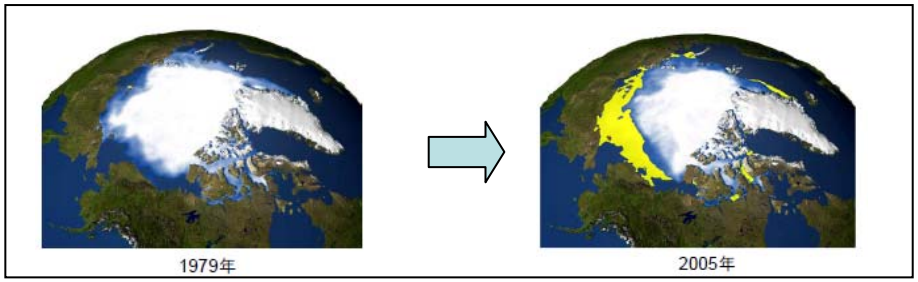
Increasing flood risk due to climate change 1

Changes in temperature in the northern hemisphere during the past one thousand years.



Excerpts from “Climactic Change 2001”, a Report of the First Working Group in the Third Evaluation Report of the IPCC

Melties of iceberg in the arctic



Inter-governmental Panel on Climate Change (IPCC)

- **Global warming is considered to be almost certain due to increasing greenhouse gases originating from human activities.**
- **The last 12 years have been the warmest 12 years since 1850.**

Rise in the average temperature and level of the sea water at the end of 21st century

	A society wherein a balance of both the environmental conservation and economic development is on a global scale	A society focused on fossil fuel, undergoing high economic growth
Rising temperatures	Approx. 1.8 degrees Celsius (1.1 to 2.9 degrees Celsius)	Approx. 4.0 degrees Celsius (2.4 to 6.4 degrees Celsius)
Rising sea levels	18 to 38 cm	26 to 59 cm

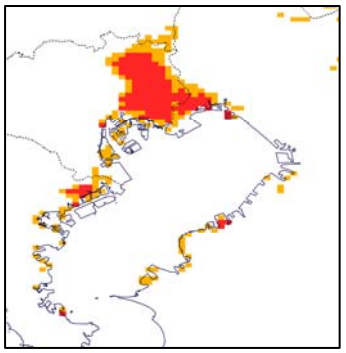
- **Increased strength of tropical low pressure systems forecasted.**
- **Some experts forecast the elimination of almost all sea ice in the Arctic Sea, during late summer seasons, by the latter half of the 21st Century.**

Global warming is actually in progress. Scientists predicted that global climate change due to global warming causes increased frequency of heavy rainfall and sea level rise.

Increasing flood risk due to climate change 2

Expansion of areas below sea level when sea level rises 60cm

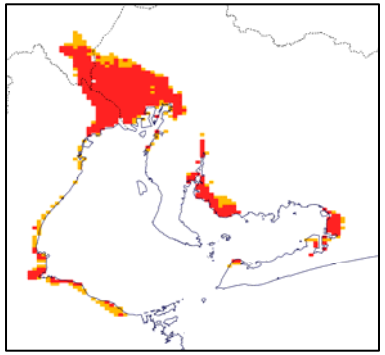
Tokyo Bay
(Yokohama City～Chiba City)



176mil.
(Today)

333mil.
(After sea level rise)

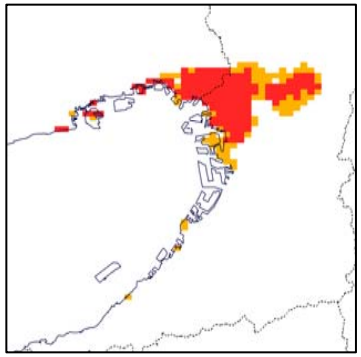
Ise Bay
(Kawagoe Town～Tokai City)



90mil.
(Today)

126mil.
(After sea level rise)

Osaka Bay
(Ashiya City～Osaka City)

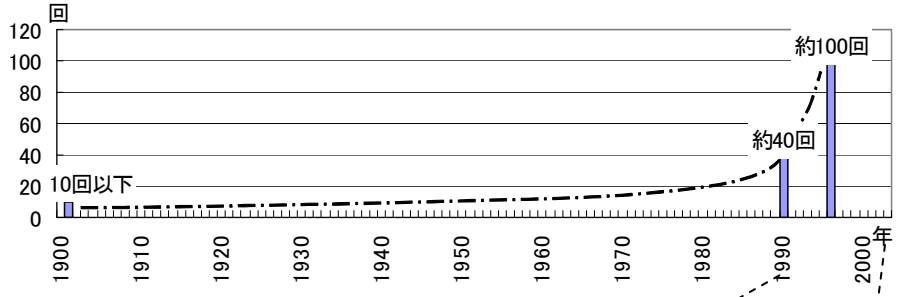


138mil.
(Today)

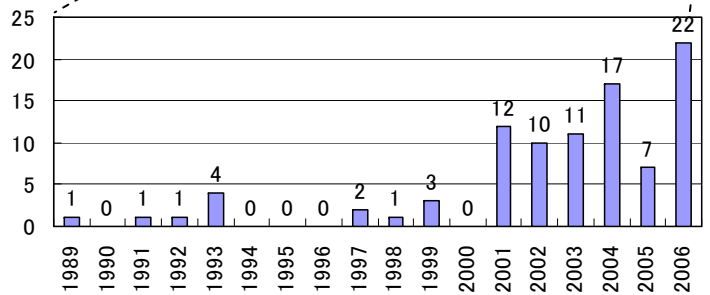
260mil.
(After sea level rise)

	Today	After sea level rise	rate
Area(km²)	577	879	1．5
Population (million)	404	593	1．5

Increasing number of inundation due to storm surge



ベニス(イタリア) St Mark's Squareの年間冠水回数
(STERN REVIEW: The Economics of Climate Changeの記述を図化)



厳島神社回廊の年間冠水回数
(厳島神社社務日誌より中国地方整備局作成)

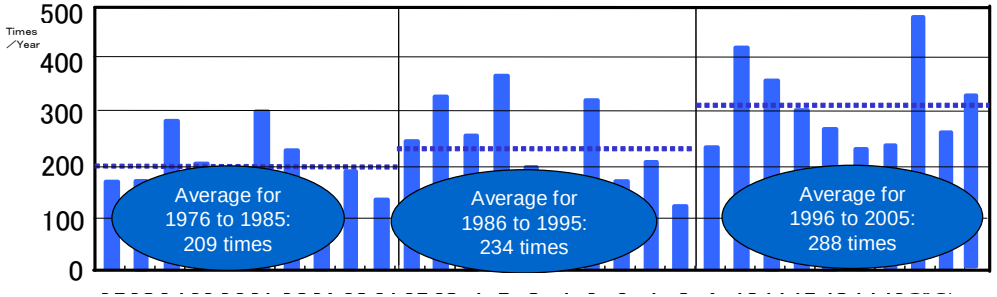
If mean sea level rises 60cm due to global warming, area and population in the area below sea level increases 50% in 3 major bay areas.

Increasing flood risk due to climate change 3

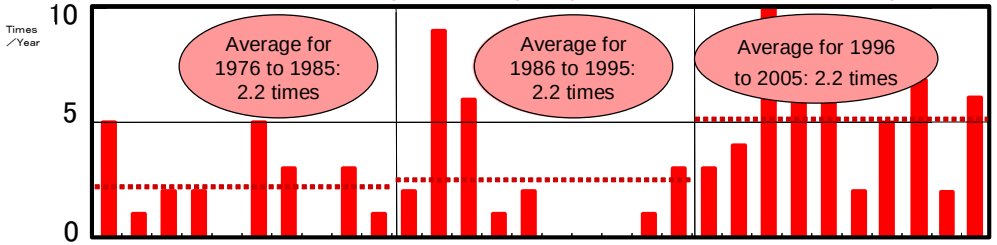
The annual occurrences of heavy rain fall per hour

(AMeDAS in approximately 1,300 points in Japan)

Number of occurrences for downpours with precipitation of 50 mm or more per hour

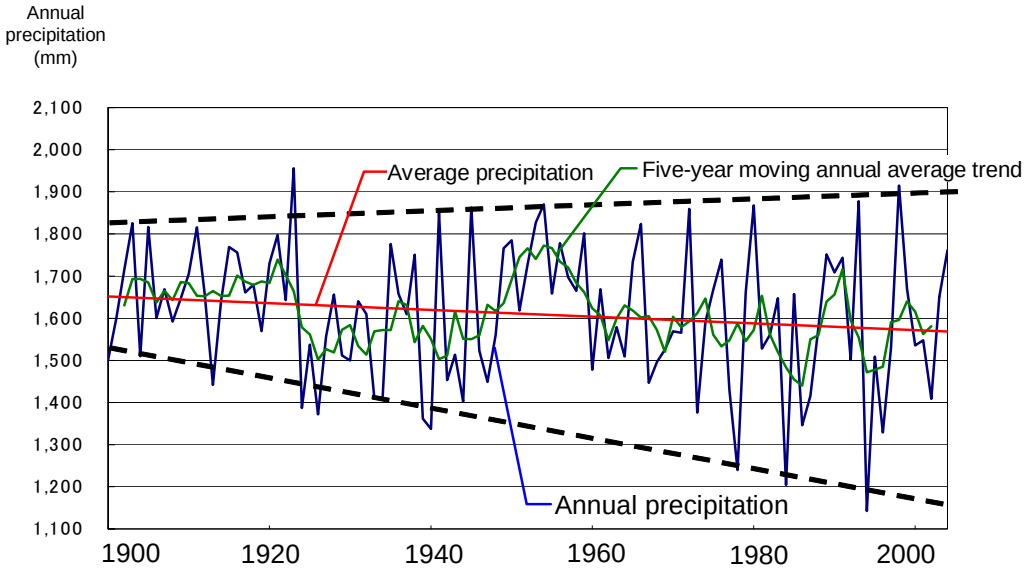


Number of occurrences for downpours with precipitation of 100 mm or more per hour



Source: The graph is made based on the resource from Japan Meteorological Agency

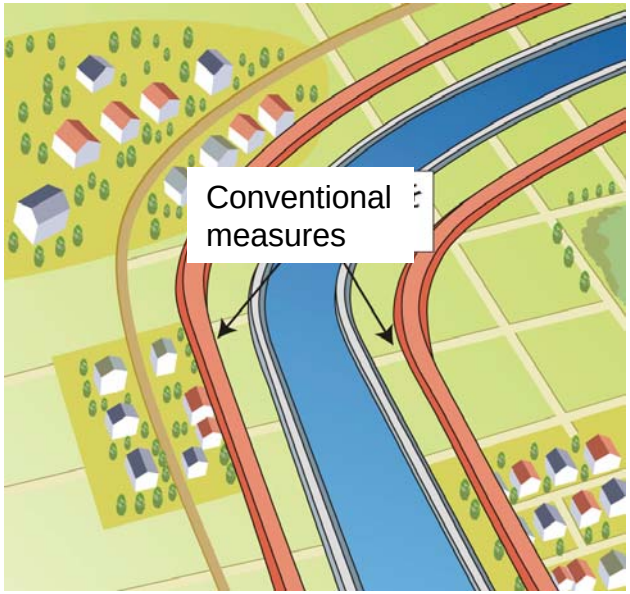
Fluctuation of precipitation for last 100 years



The annual occurrences of heavy rainfall is in increasing trend, while annual total rainfall is decreasing. Expanding fluctuation of annual rainfall causes higher risk of flood and drought.

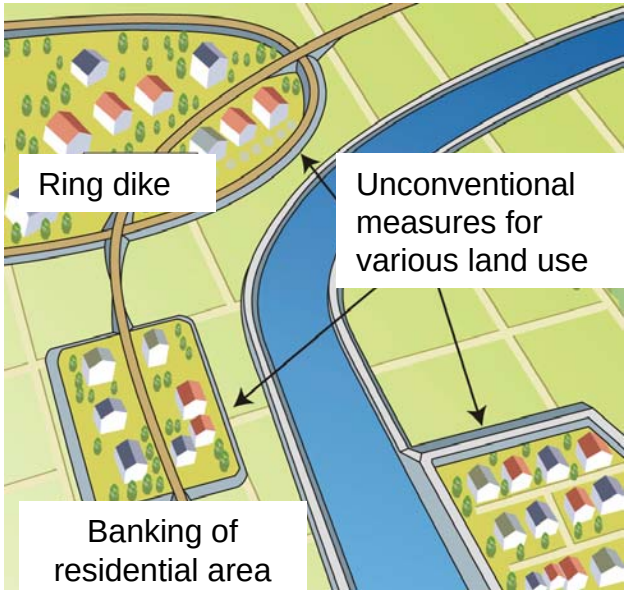
Unconventional flood management measures

Conventional flood protection by continuous levee



Conventional flood protection to construct continuous levee from downstream takes a long time for completion

New concept of flood management measures



Combination of various measures to minimize damage of floods

Example for Hiji-River in Ohzu city, Ehime Pref.

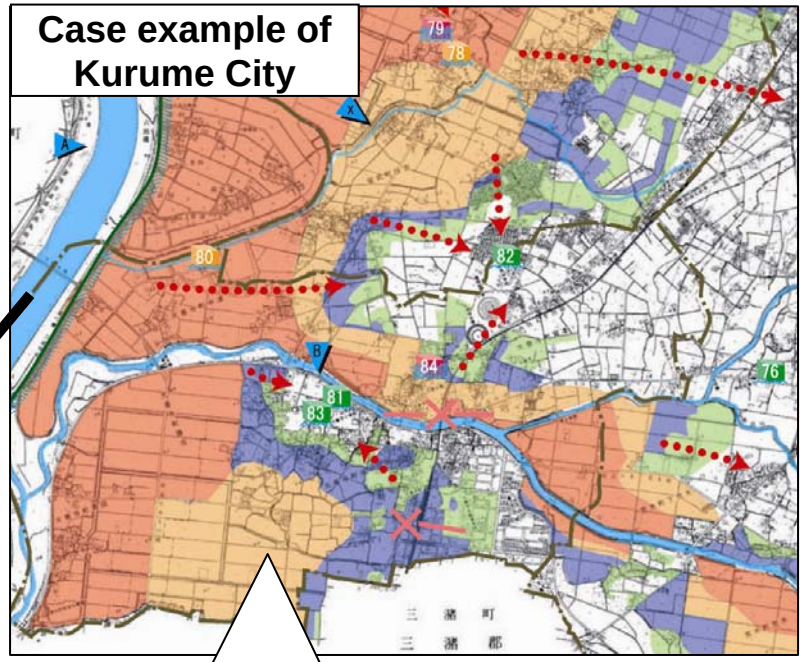
To prevent spreading of flooded water by second line levee

Introduction of disaster mitigation measures to minimize damage in addition to disaster prevention measures

Flood management combining structural and non structural measures

Publication of nationwide flood hazard maps

Case example of Kurume City



Chikugo River

Evacuation assembly points available during waterlog disasters are obvious at a glance.

Time it takes from breaching of levee to being waterlogged

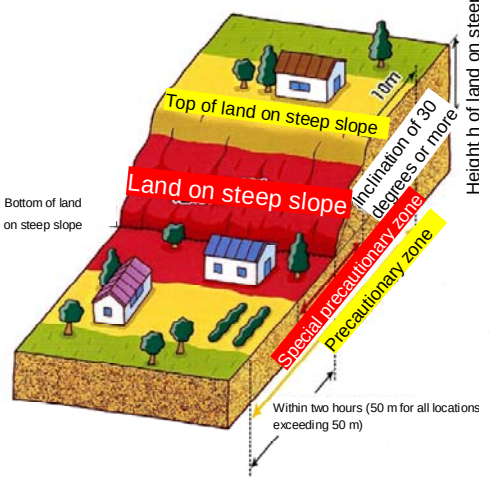
	Waterlogged above floor level within 30 minutes
	Waterlogged above floor level within 60 minutes
	Waterlogged above floor level in 60 minutes or more
	Waterlogged eventually

Designation of hazardous areas for sediment-related disasters

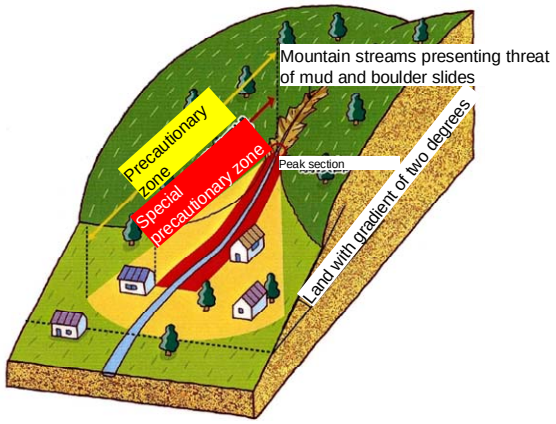
Dangerous locations clarified through zone designations

- Restrictions to land use
- Restrictions to structure of buildings
- Recommendations for the relocation of existing houses

Land slides



Mud and boulder slides



"Disaster Reduction" strategies by soft measures for minimizing the total damage