ASIA-EUROPE MEETING

Adaptation Strategy for Climate Change in Japan

- Toward Water-disaster Adaptive society -

October 3, 2008

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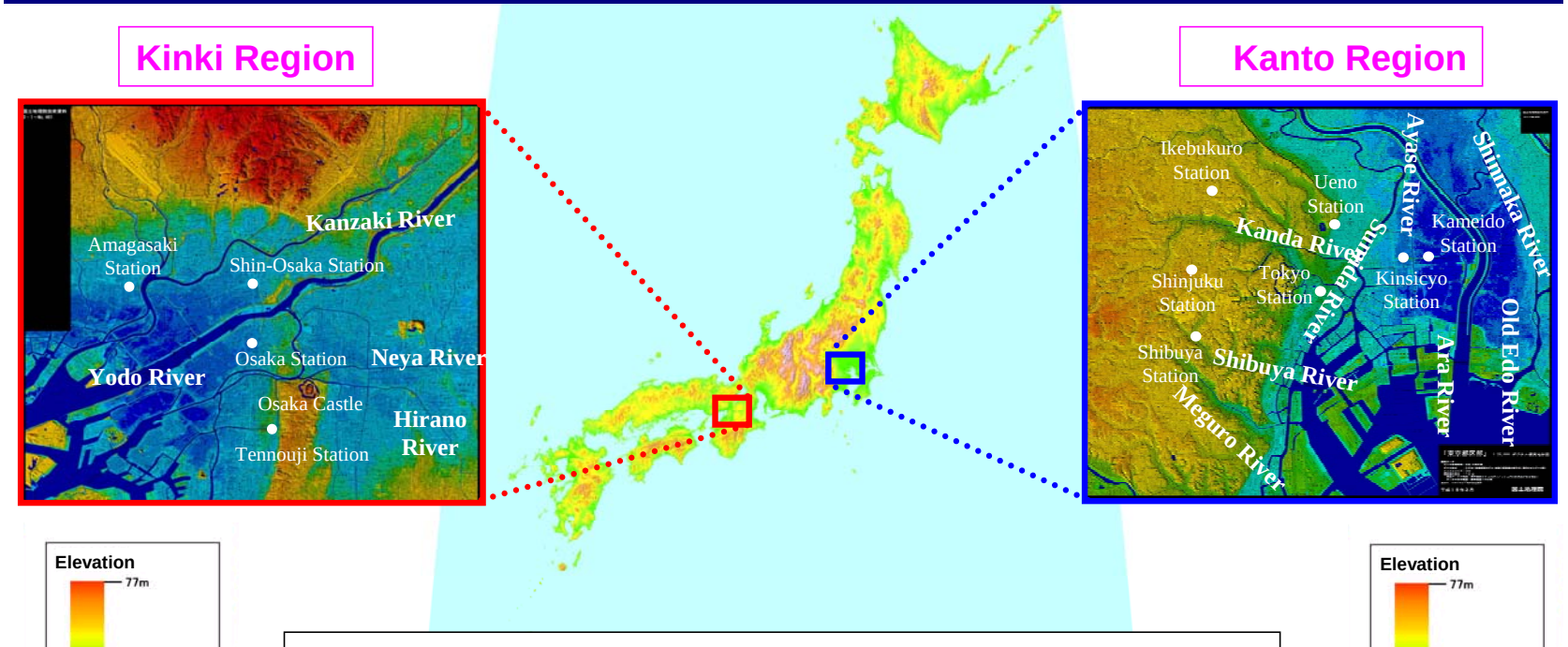
Japan is vulnerable to climate change



About 50% of population and about 75% of property on about 10% of land lower than water levels in rivers during flooding

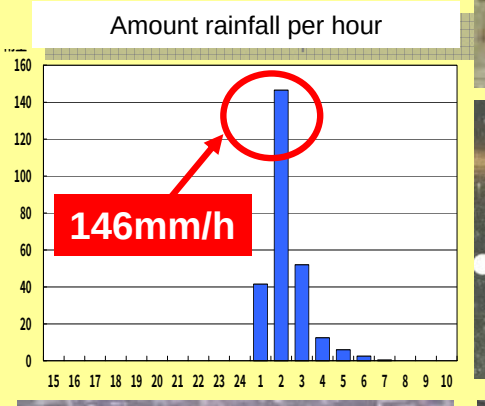
Recent Flood disasters in Japan

2008.7.28 Floods in Hyogo Pref.

Rapid water level rise of **134cm** in **10 minutes**

2008.8.29 Floods in Aichi Pref.

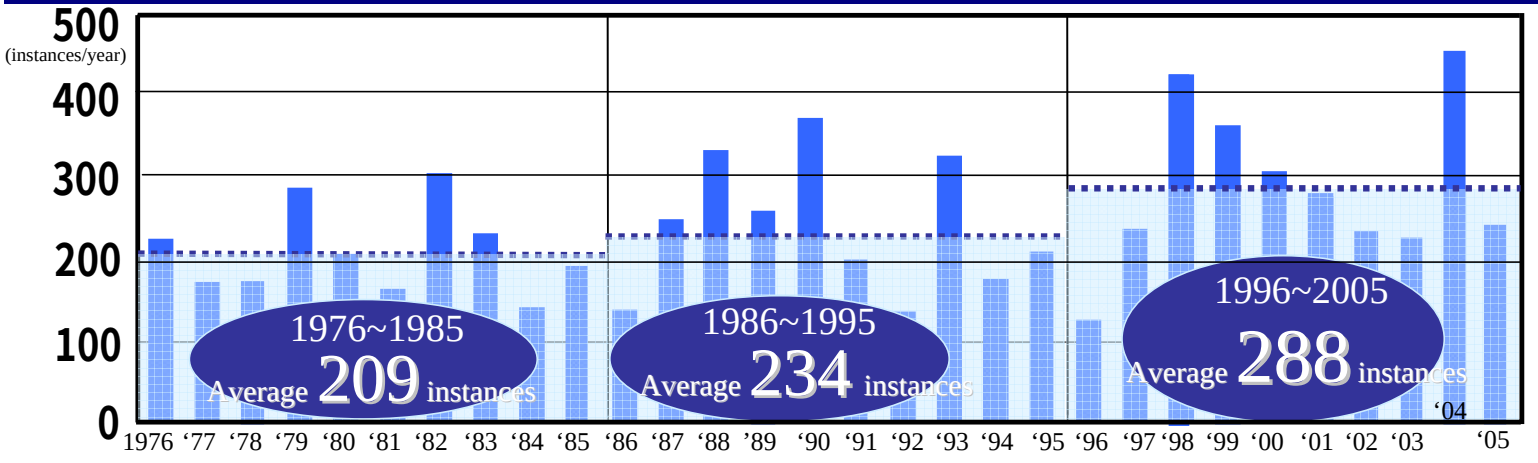
largest-ever amount rainfall per hour



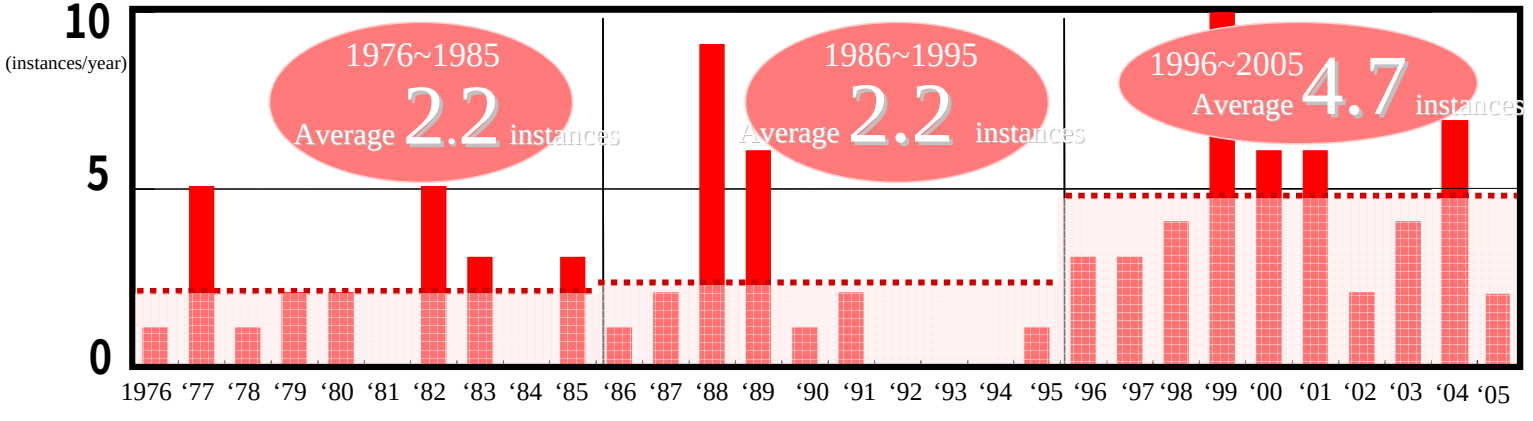
Recent Rainfall Trend

Annual total of hourly rainfall instances (from approx. 1,300 AMeDAS locations across Japan)

1. Number of instances of 50 mm or more rain in an hour



2. Number of instances of 100 mm or more rain in an hour



Mechanism of global warming and climate change

Large volumes of greenhouse gas emissions cause CO_2 concentration in the air to rise and increase heat absorption, resulting in temperature rise. Thus, global warming occurs.

- Melting of glaciers, ice caps and ice sheets
- Thermal expansion of sea water
- Change in evapotranspiration
- Change in snow accumulation condition

- Sea level rise (Maximum rise: 59 cm)
- More intense typhoons
- Increase of precipitation by a factor of 1.1 to 1.3*
- More frequent heavy rains and droughts
- Earlier snow melt and reduction of discharge

- Increase of river flow rate
- Change in water use pattern

- More frequent high tides and coastal erosions
- More frequent floods
- More serious debris flow
- Higher risk of drought

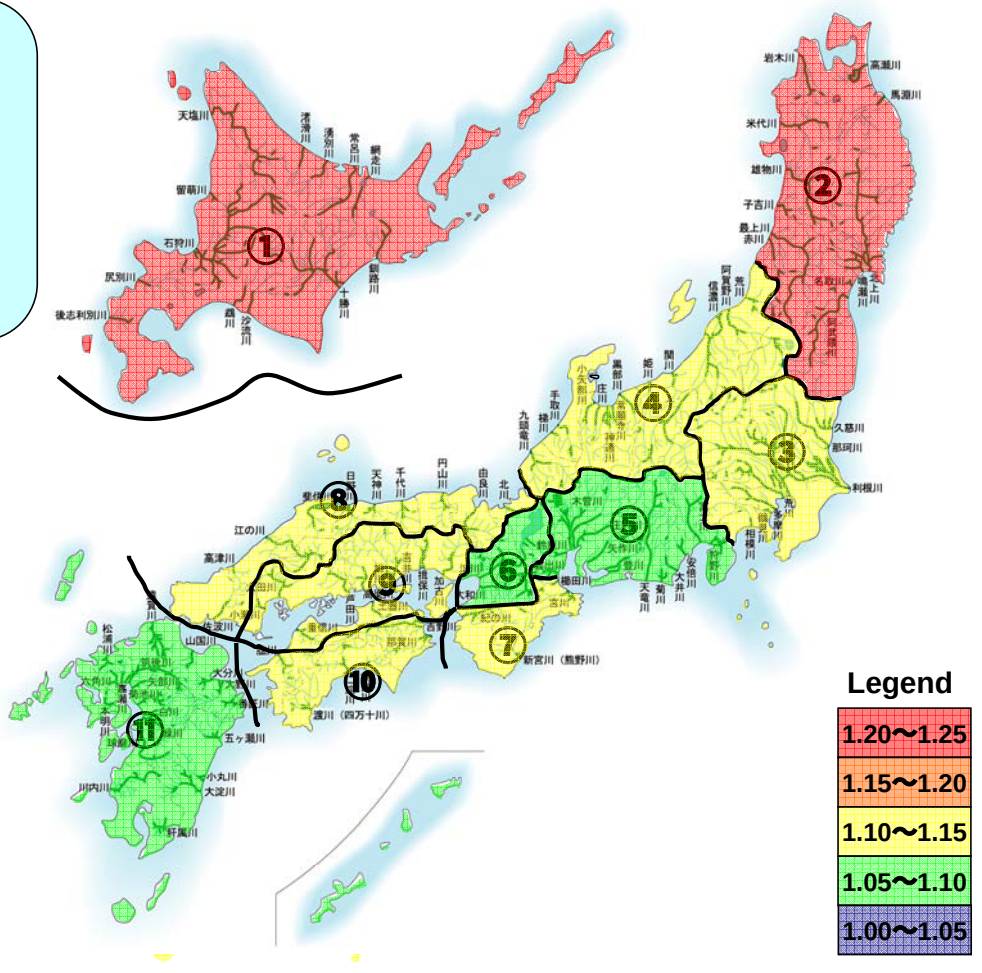
Estimation of increased rainfall in region

Future rainfall amounts were projected as a median value in each region of

$$\frac{\text{Average rainfall in 2080-2099 period}}{\text{Average rainfall in 1979-1998 period}}$$

The above equation was obtained based on the maximum daily precipitation in the year at each survey point identified in GCM20 (A1B scenario).

①	Hokkaido	1.24
②	Tohoku	1.22
③	Kanto	1.11
④	Hokuriku	1.14
⑤	Chubu	1.06
⑥	Kinki	1.07
⑦	Southern Kii	1.13
⑧	San-in	1.11
⑨	Setouchi	1.10
⑩	Southern Shikoku	1.11
⑪	Kyushu	1.07

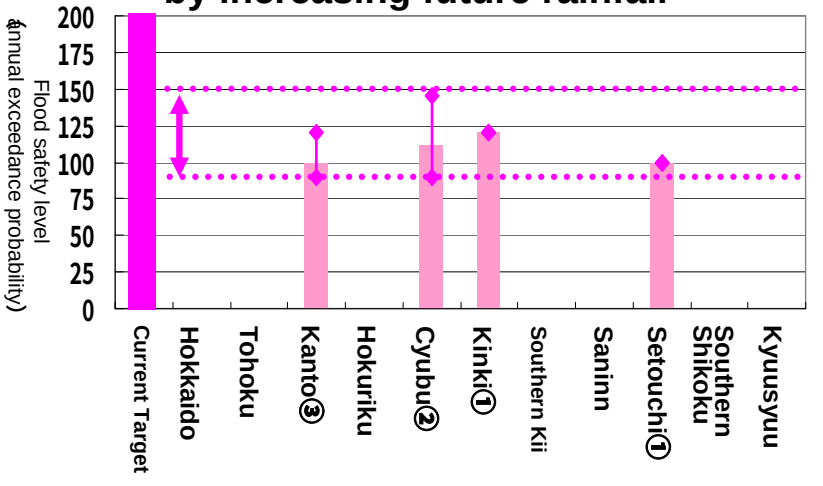


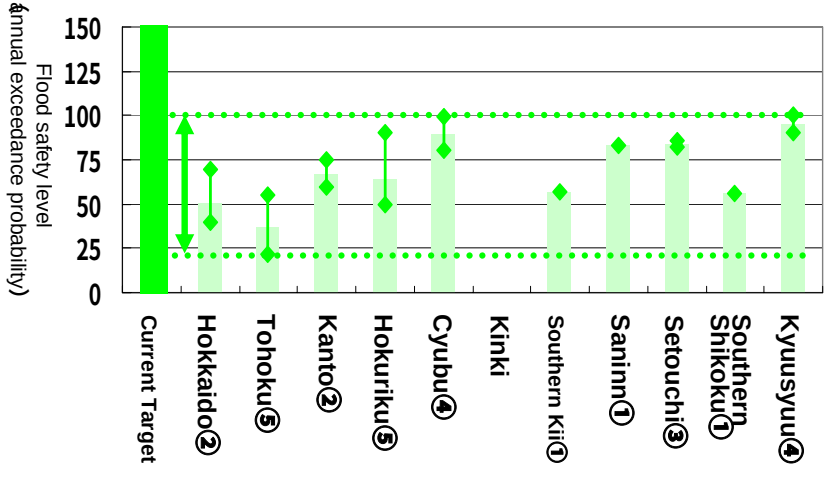
Declining the degree of safety level

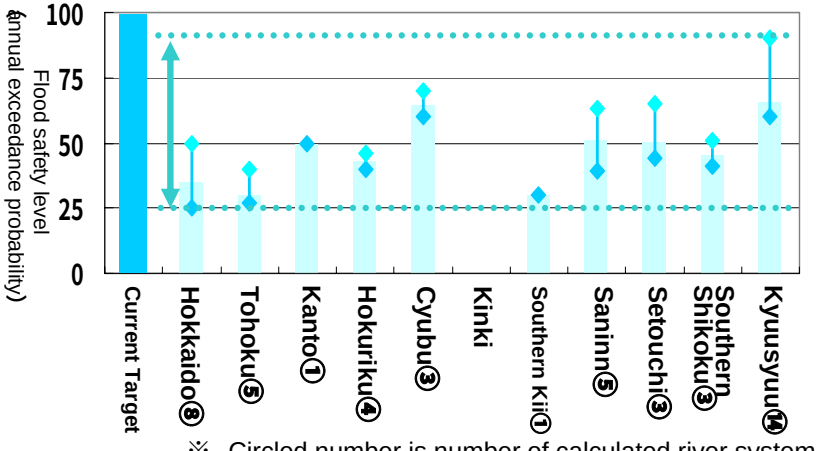
Impact for flood safety level by changing rainfall after 100 years

Region	1/200 (CurrentTarget)		1/150 (CurrentTarget)		1/100 (CurrentTarget)	
	Future flood safety level (annual exceedance probability)					
		Number of river system		Number of river system		Number of river system
Hokkaido	—	—	1/40～1/70	2	1/25～1/50	8
Tohoku	—	—	1/22～1/55	5	1/27～1/40	5
Kanto	1/90～1/120	3	1/60～1/75	2	1/50	1
Hokuriku	—	—	1/50～1/90	5	1/40～1/46	4
Cyubu	1/90～1/145	2	1/80～1/99	4	1/60～1/70	3
Kinki	1/120	1	—	—	—	—
Southern Kii	—	—	1/57	1	1/30	1
Saninn	—	—	1/83	1	1/39～1/63	5
Setouchi	1/100	1	1/82～1/86	3	1/44～1/65	3
Southern Shikoku	—	—	1/56	1	1/41～1/51	3
Kyusyu	—	—	1/90～1/100	4	1/60～1/90	14
All Japan	1/90～1/145	7	1/22～1/100	28	1/25～1/90	47

Declining the degree of safety against flood by increasing future rainfall



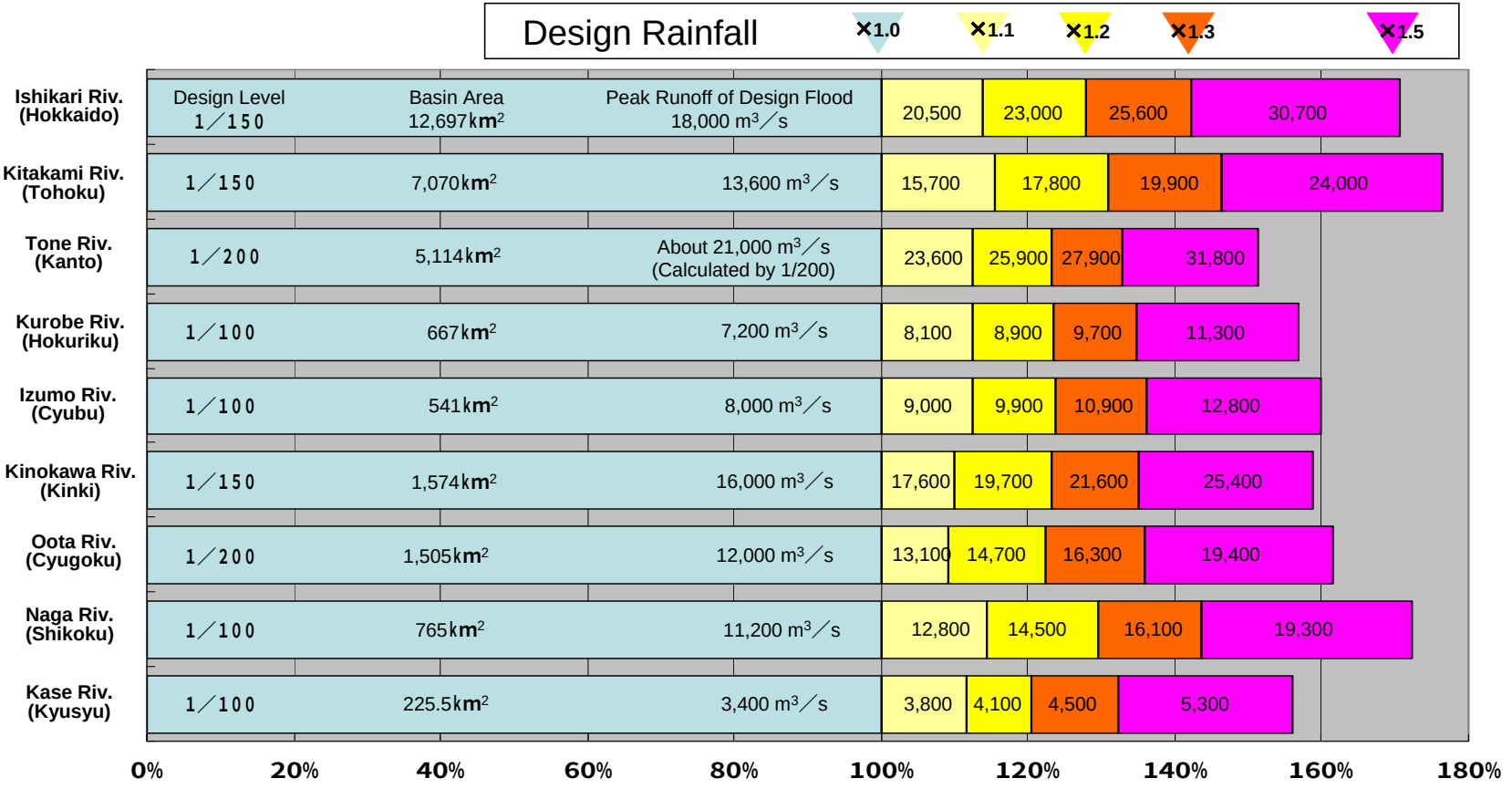




※ Circled number is number of calculated river system

Changes of peak runoff by future rainfall

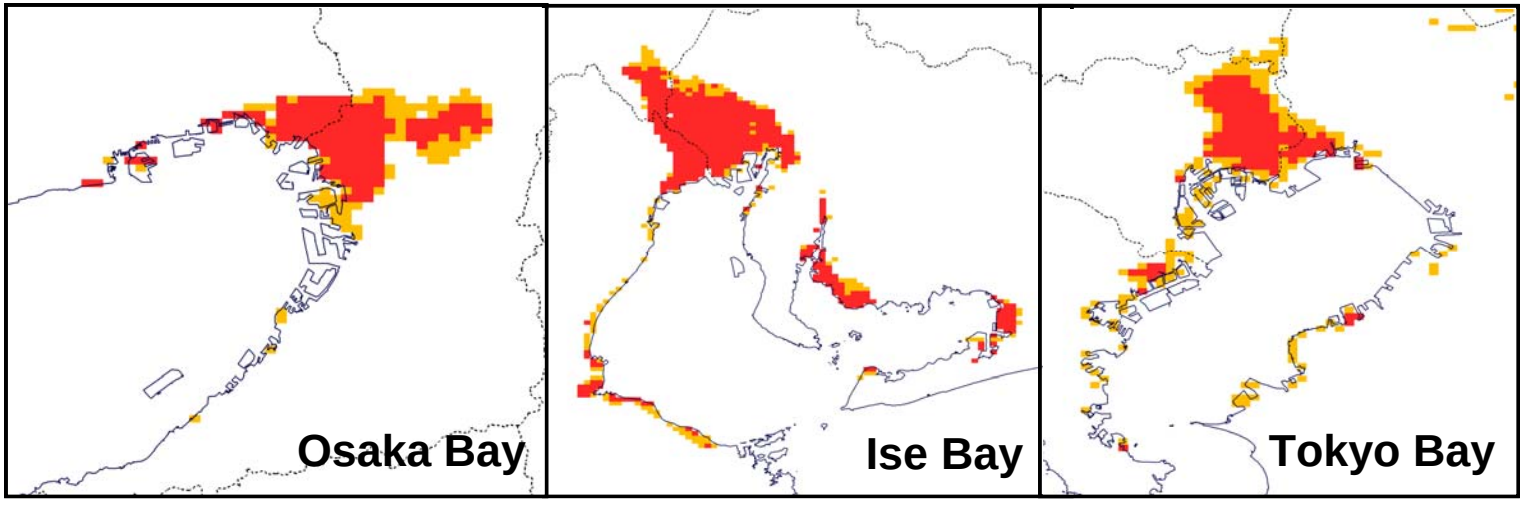
Estimations of future rainfall are about ×1.1 ～×1.5 compare to current rainfall. Peak runoff will be estimated about ×1.1 ～×1.7 compare to current peak runoff in 9 major rivers.



Impacts of sea level rise

below-sea-level areas in Three Large Metropolitan Areas

(Tokyo Bay, Ise Bay and Osaka Bay)



Areas with flood risks due to high tides will increase.

*Prepared by the River Bureau based on the national land-use digital information.
*Shown are the areas at elevations lower than sea level shown in a three-dimensional mesh (1 km x 1 km). Total area and population are based on three-dimensional data.
*No areas of surfaces of rivers or lakes are included.
*A premium of 60% is applied to the potential flood risk area and to the population vulnerable to flood risk in the case with a one-meter rise of sea level.

	Present	After sea level rise	Rate of increase
Area (km^2)	559	861	1.5
Population (Million)	3.88	5.76	1.5

Basic concept of adaptation strategies

Climate change due to global warming is expected to induce the following phenomena in coastal and low-lying areas.

-More frequent heavy rains and more intense typhoons

⇨ Frequent and serious flood and sediment disasters

-Sea level rise and more intense typhoons

⇨ Frequent and serious high tides and coastal erosions

-Wider range of variation of rainfall intensity and change of river flow regime

⇨ Frequent and serious droughts

Basic concept for Future ideal society

Combining mitigation and adaptation aiming at ‘’ Water -disaster adaptive society’’

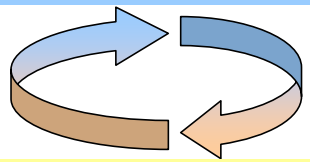
Basic direction of climate change adaptation strategies

1. Adaptation measures to achieve “Zero casualty" should be considered, because ‘’Zero damage’’ from disasters is difficult.
2. In a nerve center like the Tokyo metropolitan area, intensive efforts should be made such as preventing from ceasing national function

Adaptation strategies

Counter-Measures for Climate Change

Mitigation Measures



Adaptation Measures

- Multiple measures
- Effective& Efficient Adaptation Programme
  - Risk Assessment -

Facility

Ex) Dike, Dam, Discharge, Infiltration trench, …

Regional Development

Ex) Land use regulation, Building restriction, Circle levee, …

Crisis Management

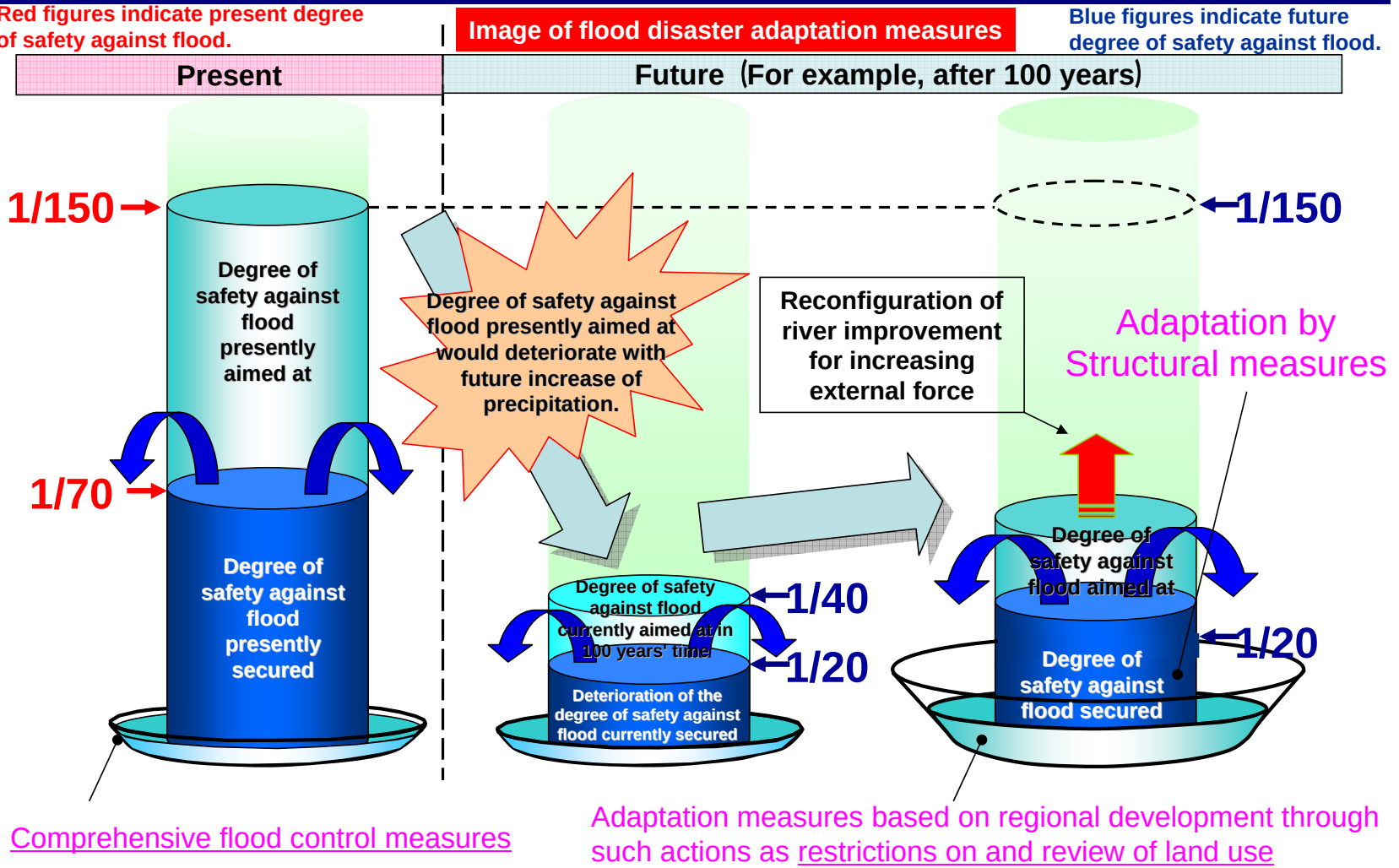
Ex) Flood Hazard Map, Real-time information, TEC-Force, …

Monitoring

Ex) River Information, Planning, Revision of plan, …

Multiple measures for increasing in risk

3.Adaptation measures for climate change



Process of effective and efficient adaptation program

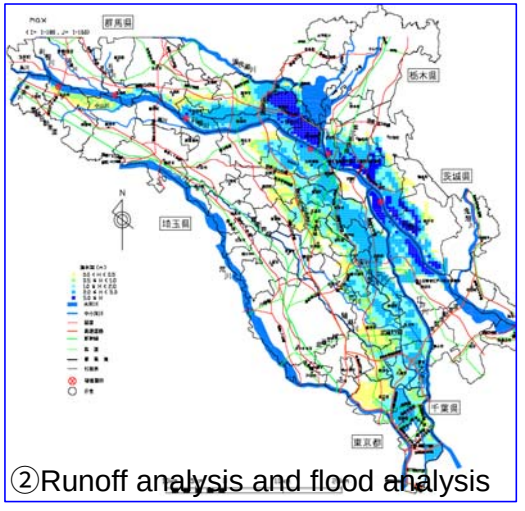
①Review of past flood

②Runoff analysis and flood analysis

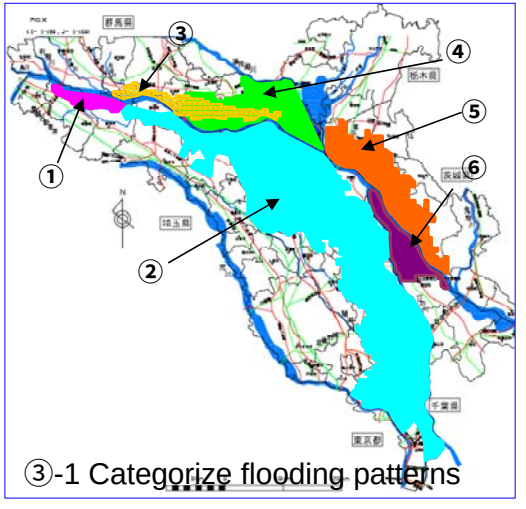
③Categorize flooding pattern in each category

④Calculate damage and effect

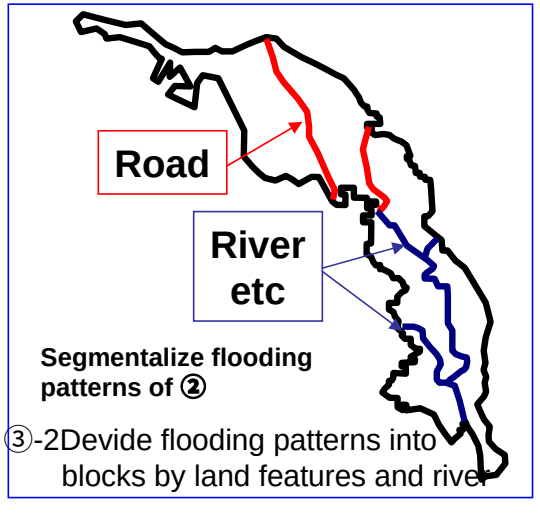
⑤Consider effective and efficient adaptation measures



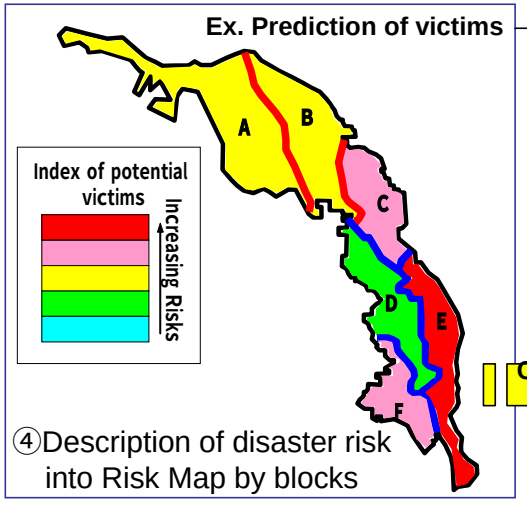
②Runoff analysis and flood analysis



③-1 Categorize flooding patterns

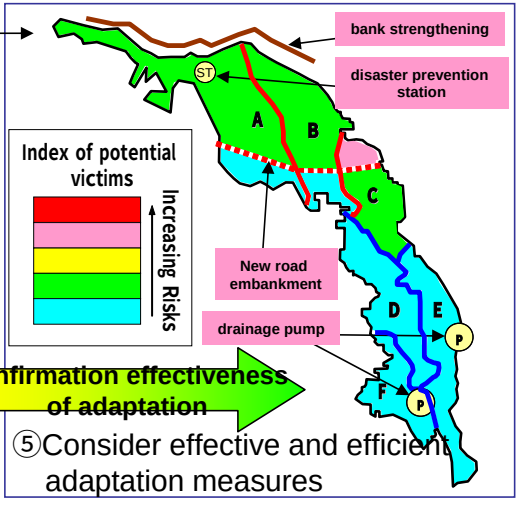


③-2Devide flooding patterns into blocks by land features and river



④Description of disaster risk into Risk Map by blocks

Confirmation effectiveness of adaptation



⑤Consider effective and efficient adaptation measures

Adaptation by structures

Improvement of the reliability of structures, full and long-life utilization of existing structures

Constructing new structures

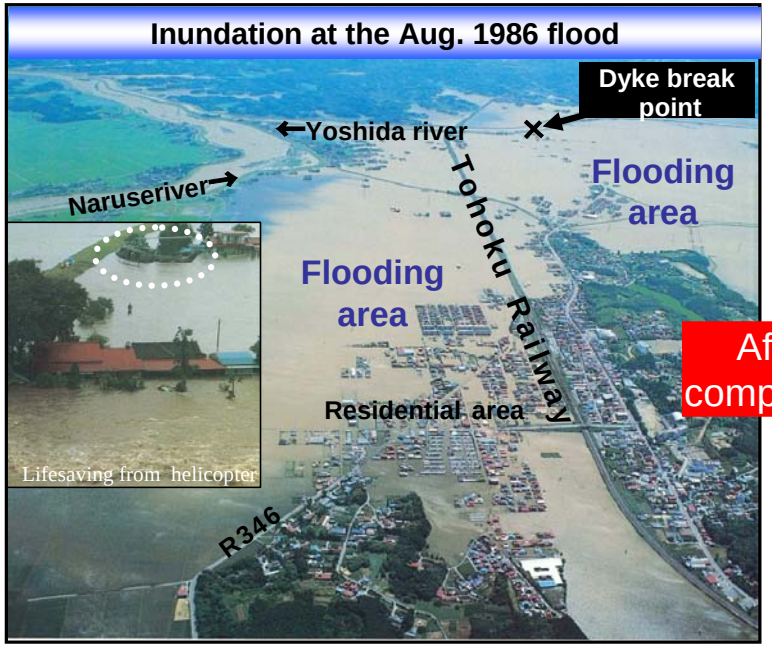
Flood control (Dam)

Underground discharging Channel

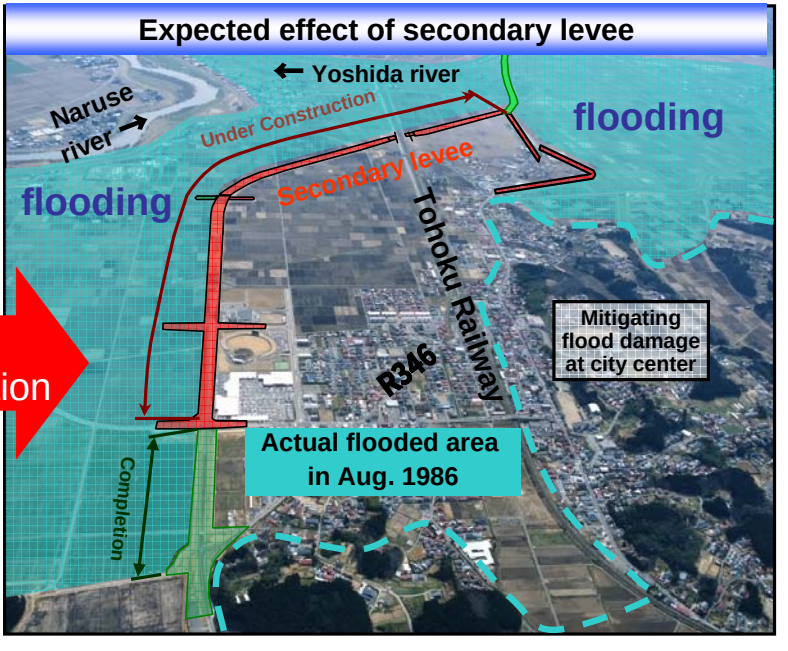
High standard embankments

Adaptation by structures

Floodwater control with secondary levees in coordination with road construction to prevent expansion of damaged area



After completion

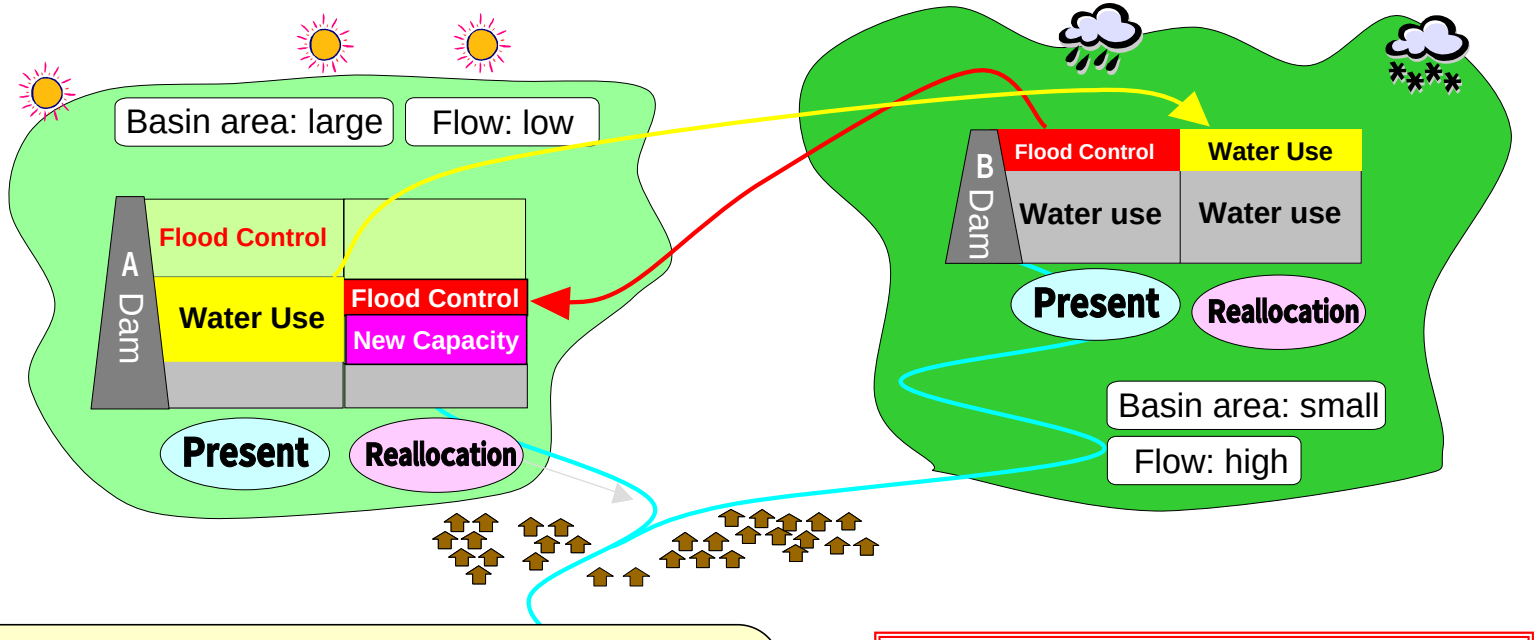


At the 1986 flood, 3,060ha was flooded, 1,510 houses were flooded above the floor level, and some parts of the area stayed under water up to 12 days.

This secondary levee is under construction in coordination with road construction.

Adaptation by structures
- Effective Use of existing structure

Based on the deep consideration on characteristics of river basin, re-allocation of Multi-purpose dam's capacity can be more effective in terms of flood-control and water-use



Re-allocation of Multi-purpose dam's capacity

- Re-allocation of water use capacity to flood control capacity.
- Capacity allocation among existing and newly-planed dams

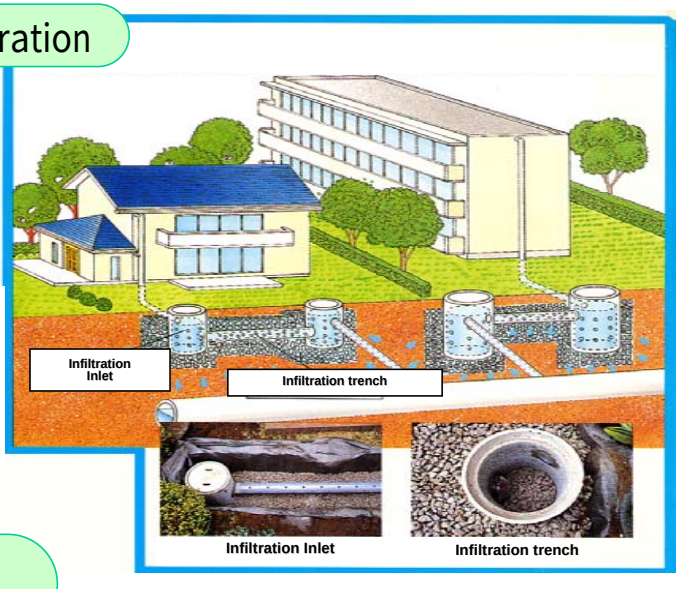
Re-allocation will improve Flood Control, and Water Resource Use more effectively

Adaptation in river basin
- Storage, infiltration and forest conservation in river basin

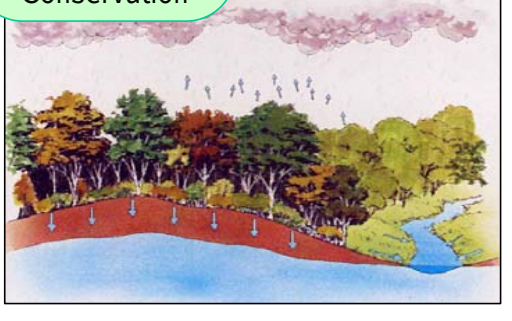
Storage

Storage facilities in schools, parks and public houses

Infiltration



Forest Conservation

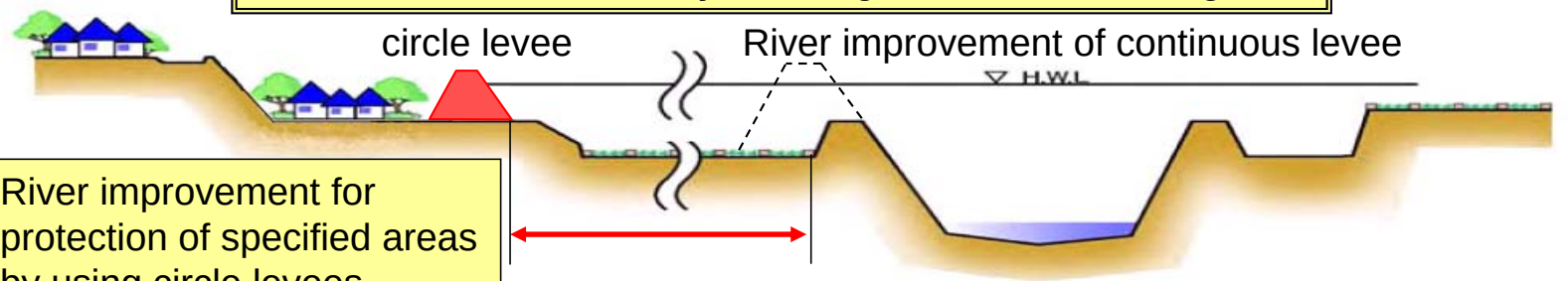


◆Purchase and conservation of forest in developing area

Adaptation measures in step with local community development

Response to floods that cannot be dealt with by facility-based measures, through land use or community development allowing inundation.

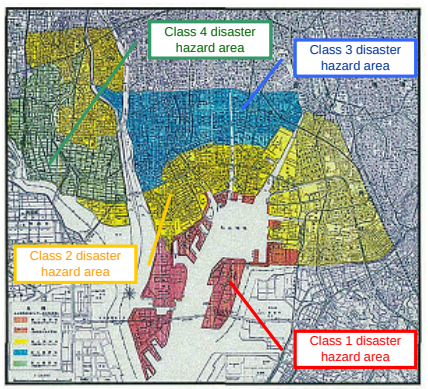
Shift to land use or ways of living that minimize damage



River improvement for protection of specified areas by using circle levees

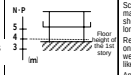
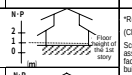
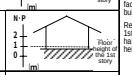
Designation of potential disaster hazard area

Restrictions on land use by designating potential disaster hazard areas



Nagoya city

Building restrictions

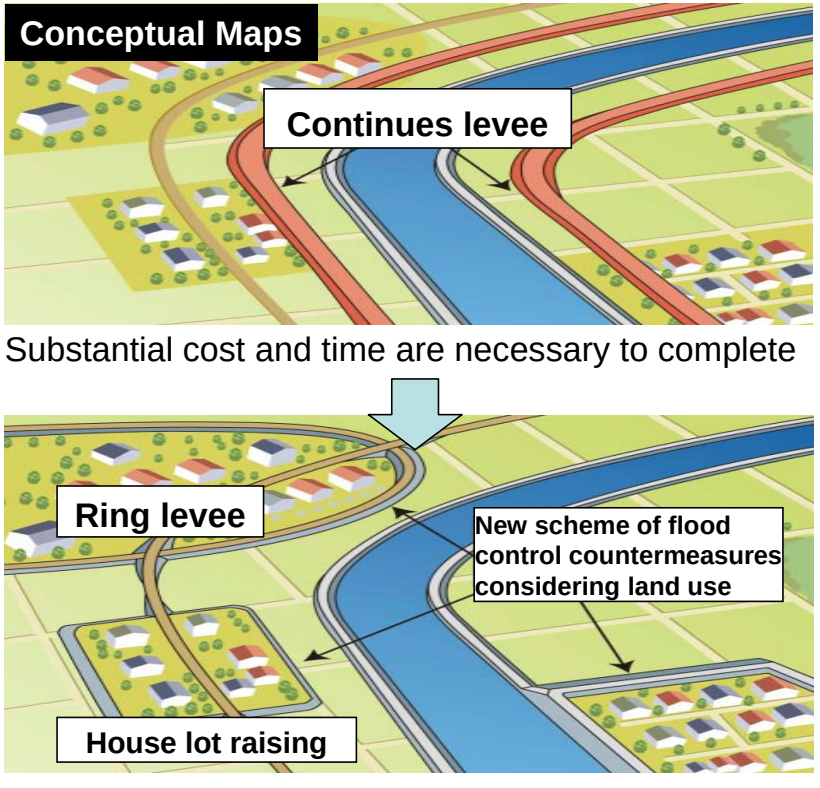
	Floor height of the 1st story	Structural restriction	Illustration	
Class 1 zone (Urbanization promotion area)	N-P (+) 4m or more	Wooden structure is prohibited.		*No buildings shall be constructed. Scope --- Areas designated by the mayor the distance from which to any shore line or riverbank line is not longer than 50 meters. Restriction --- Any building having one habitable room or more, hospital, welfare facility for children, and the like shall not be constructed. Any building of non-wooden construction may be constructed, provided that the height of the floor of any habitable room, etc. is not less than N-P (+) 5.5m or more.
Class 2 zone (Urbanization promotion area)	N-P (+) 1m or more	Any habitable room shall be located on the second story or Relaxation: For a building with a total floor area no more than 100m², the aforementioned restriction may be replaced with the provision of an evacuation room and evacuation equipment.		*Restriction on public buildings (Classes 2 to 4 zones) Scope --- Schools, hospitals, assembly halls, public offices, welfare facilities for children, and other public buildings similar thereto. Restriction --- The floor height of the 1st story shall be N-P (+) 2m and any habitable room shall be located at a height of N-P (+) 3.5m or higher.
Class 3 zone (Urbanization promotion area)	N-P (+) 1m or more			
Class 4 zone (Urbanization control area)	N-P (+) 1m or more	Any habitable room shall be located on the second story or higher.		

Community planning to inundation

Piloti-type building to avoid damage during a flood

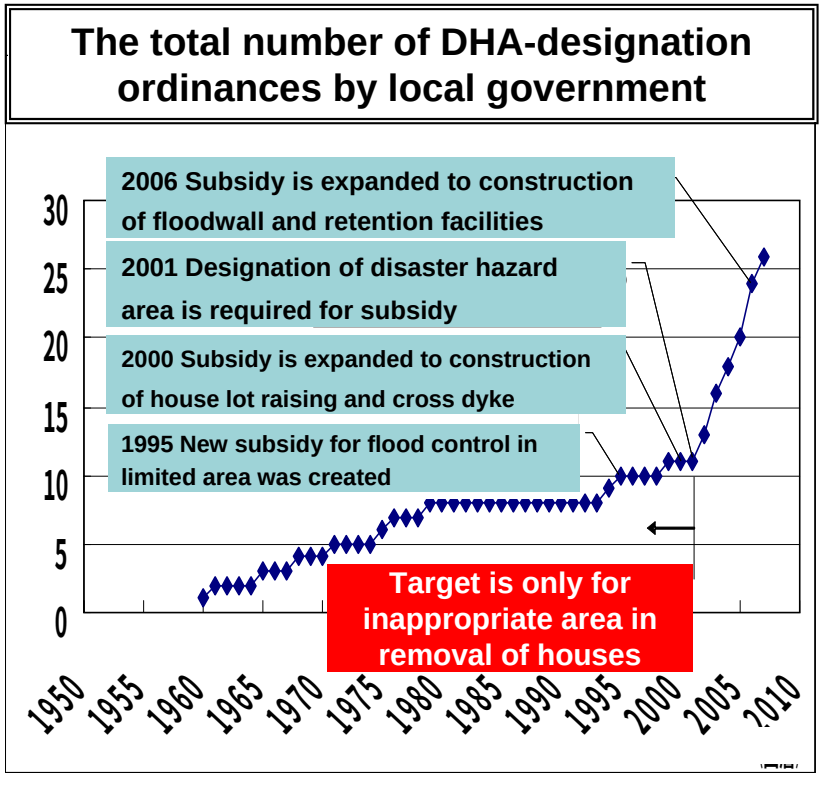
Adaptation measures in step with local community development

More local governments established ordinances including the designation of disaster hazard areas (DHA) for cost and time-effectiveness



Substantial cost and time are necessary to complete

New counter-measures linked with land-use can be implemented faster (e.g. ring levee, house lot raising)



A new concept for urban development：
Compact community easier to implement flood control measures

Compactly-built residences provide better energy efficiency and easier environment for flood control projects

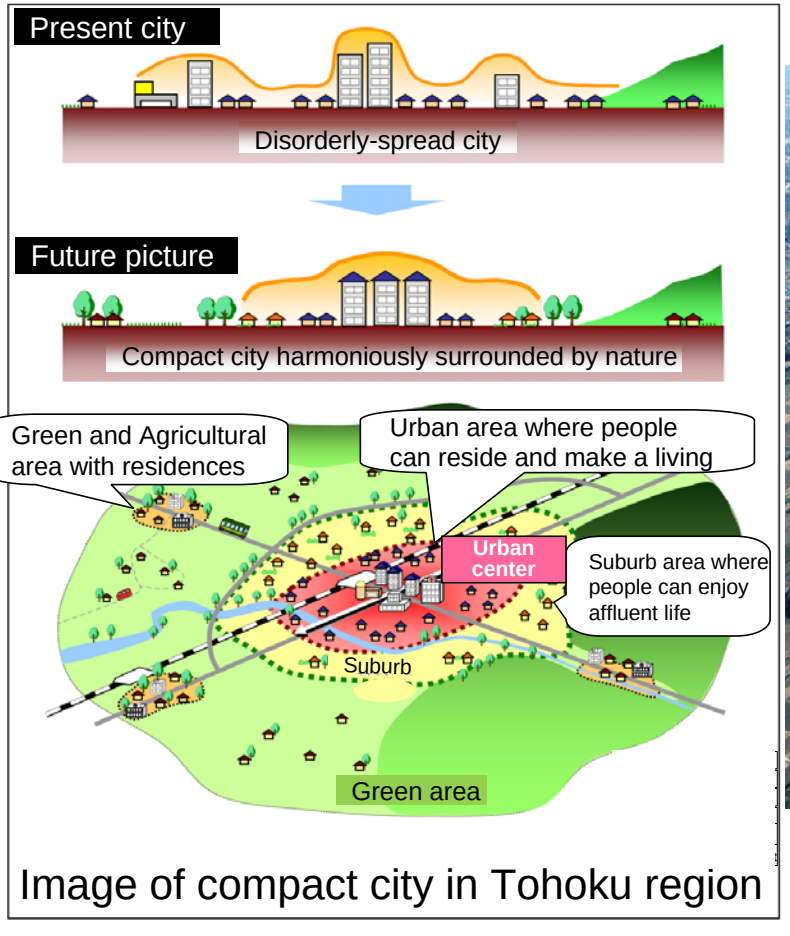
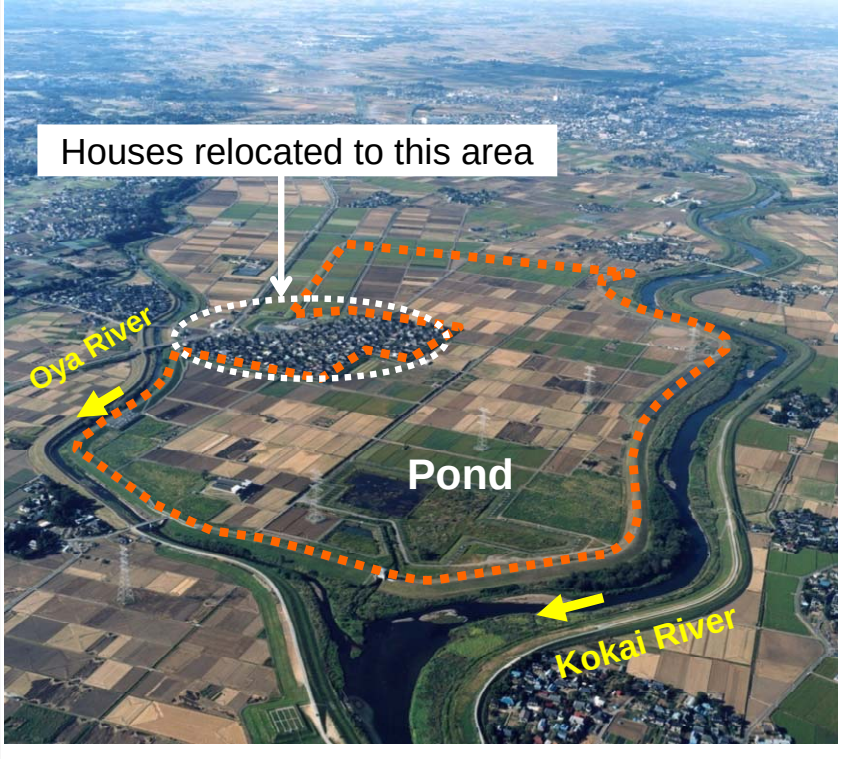


Image of compact city in Tohoku region



Hakojima retarding basin
(constructed in 1990)

A new concept for urban development:
urban development for a low-carbon, water-disaster adaptive society

3.Adaptation measures for climate change

Urban development should be promoted to build a low-carbon society which is also resilient to floods.

Integrated project (Lake Town Development Project)

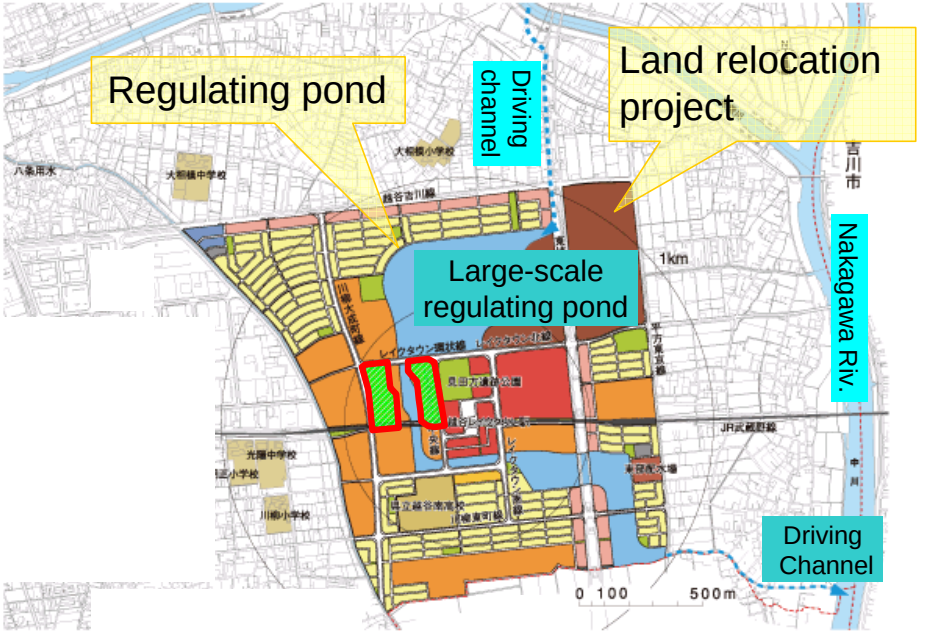
Construction of a regulating pond as a flood control project

+

Urban development by a land relocation project

Plus adaptation

Project to reduce CO_2 emission by 20% from the town



Urban renovation with both mitigation and adaptation

Adaptation measures with emphasis on crisis management

Share preliminary information concerning the degree of flood risk

Water levels in built-up areas in the past floods are indicated on the hazard map.

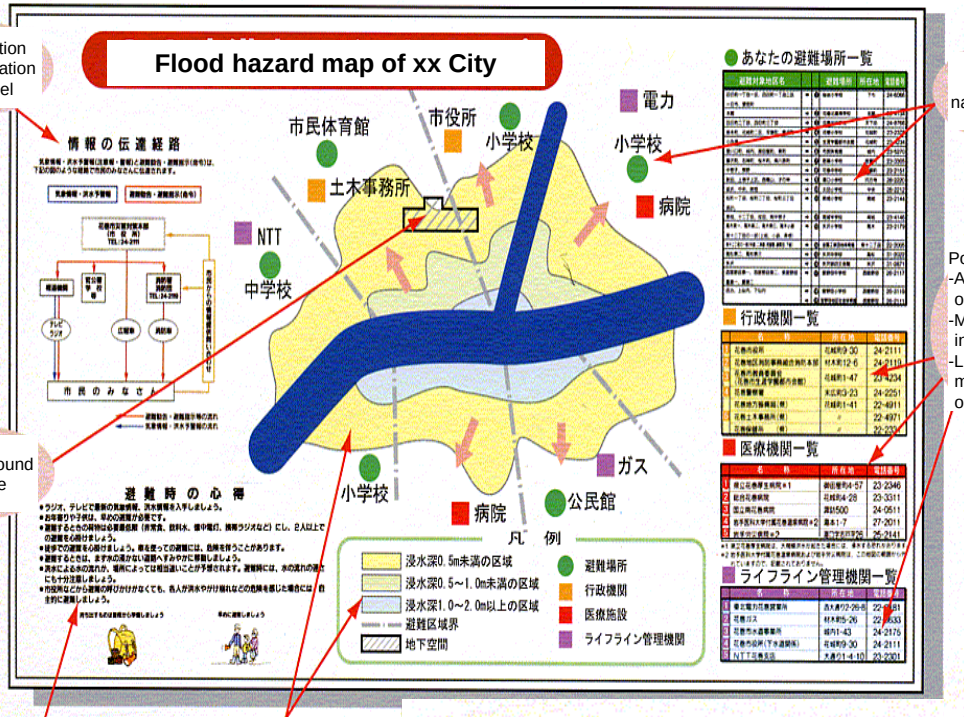


Image of a flood hazard map

Information dissemination channel

Underground space

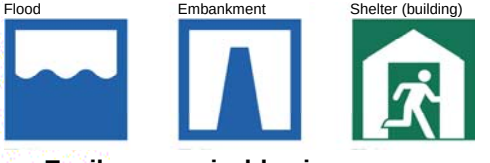
Hints on escape and necessities

Potential inundation areas and depths of inundation

Locations and names of shelters

Points of contact
-Administrative organizations
-Medical institutions
-Lifeline systems management organizations

Toyooka City, Hyogo Prefecture

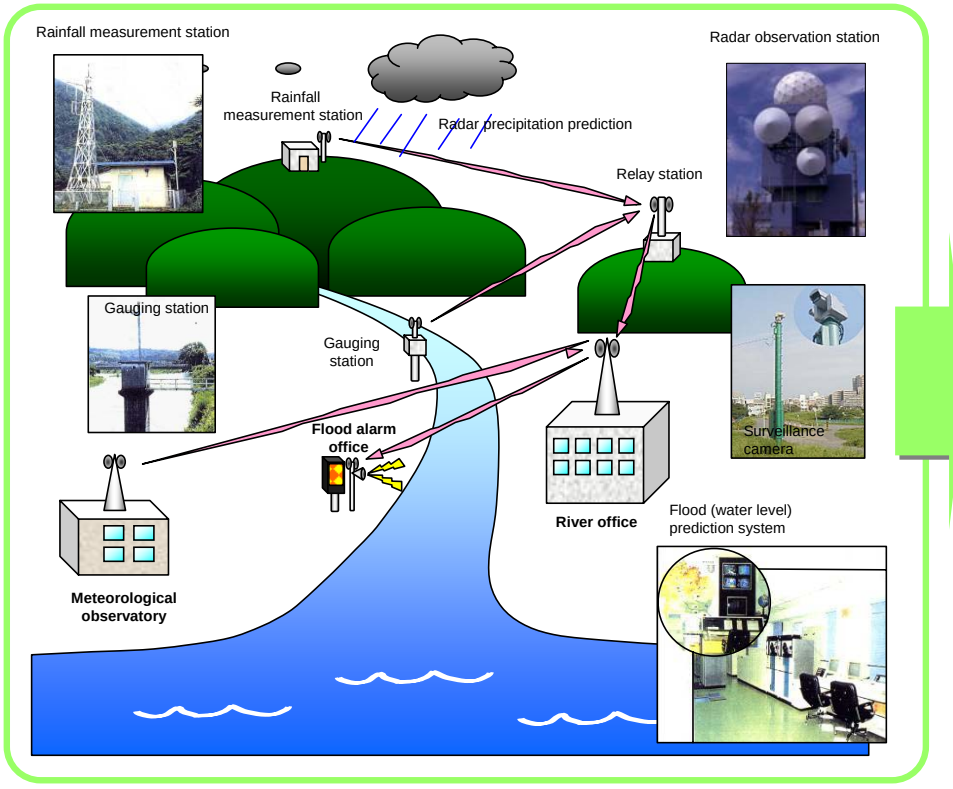


Easily recognizable signs

Adaptation measures with emphasis on crisis management

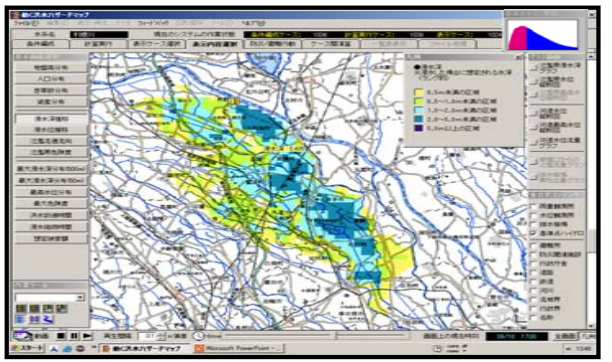
Share real-time information

- Provision of rainfall amounts and water levels real-time via cellular phone, the Internet or local disaster prevention radio
- Flood forecasting through real-time simulation



Information provision via cellular phone or personal computer

Delivery of an image to a TV screen



Floodwater prediction through real-time simulation

Adaptation measures
with emphasis on Capacity Building & Public Awareness

To organize local meetings and raise public awareness on preparedness on disaster

Education for pupils

Annual educational course for pupils on disaster preparedness at the Center

Disaster preparedness caravan

To visit local meetings and explain to residents

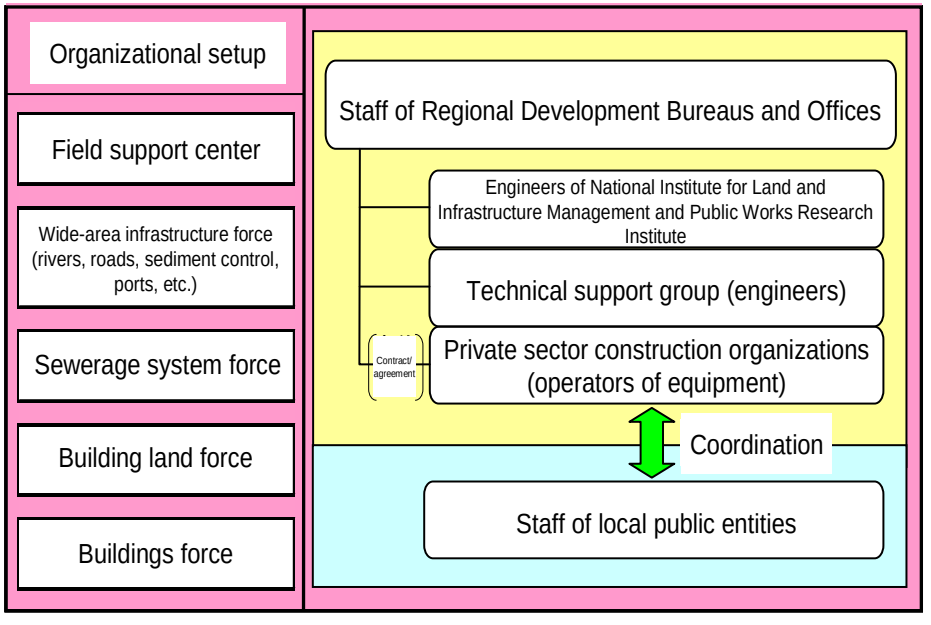
Tsurumi River Administration Center

Adaptation measures with emphasis on crisis management

Reinforcement of actions in the initial stages of a disaster for minimizing damage and restoring infrastructure early, and enhancement of an organizational setup to achieve the goal

TEC-FORCE started in 2008

(Technical Emergency Control Force)



Activities

-Investigation of damage
-Quick repairing
-Prediction of degree of damage risk
-Planning of control measures
-High-level technical guidance
-Assistance in reconstruction

Conclusion

①Prioritized investment to disaster prevention

- ✓Investment prioritize areas related to disaster prevention for limitation of available capacity

②Clarification of priority and Planning of road map

- ✓Drawing up short-term, middle-term, long-term policy by [selection and concentration] as meaning of clarification of prioritized measures.
- ✓Planning the road map by assessment of disaster risk in multiple measures (e.g. structure, land-use, preparedness)

③Adoption adaptive approach

- ✓Adopting adaptive approach of revising road map in response to future observation and cumulative knowledge

④New technical development and contribution to the world

- ✓Contributing to the world by transferring of new technology and Japanese expertise, policy, technology

⑤Participatory approach

- ✓Participatory approach is necessity. Informing to be understood easily to citizens.