Recovery of Clean Water
Watershed Water Quality Management

Water & Waste Eng.
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名古屋大学減災連携研究センター
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Japanese Experiences of Industrial Pollution

- Itai-itai disease(1912): River water pollution from mining, heavy metals such as cadmium
- Minamata disease(1956): Water pollution from plant, food containing methylmercury compounds
- Niigata Minamata disease(1965): Water pollution from plant, methlymercury compounds
- Yokkaichi asthma(1961): Air pollution from petrochemical plants, sulfur dioxide

Recovery of clean water; laws, regulations and technology for water pollution control

- the historical background of water pollution and the conditions of under which the Minamata and Itai-itai diseases occurred are explained.
- the purpose of laws; to prevent water pollution
- more stringent prefectural standards, wastewater treatment systems and technologies for improving of water quality, and monitoring systems by telemeter.

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Integrated Lake Basin Management

Water Supply and Sanitation Challenges:

- International decade for water supply and sanitation: 1978-1989
- Interim period toward MDG 1990-2001
- MDG and SDGs

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Unique Features of Lakes

- Integrating nature
  - everything comes together
- Long retention time
  - problems remain long
  - finding solutions also takes long time
- Complex response dynamics
  - everything affects everything else in water

ILBM Principles

- Lentic water system
- Change in resource value
- Ecological service
- Governance improvement

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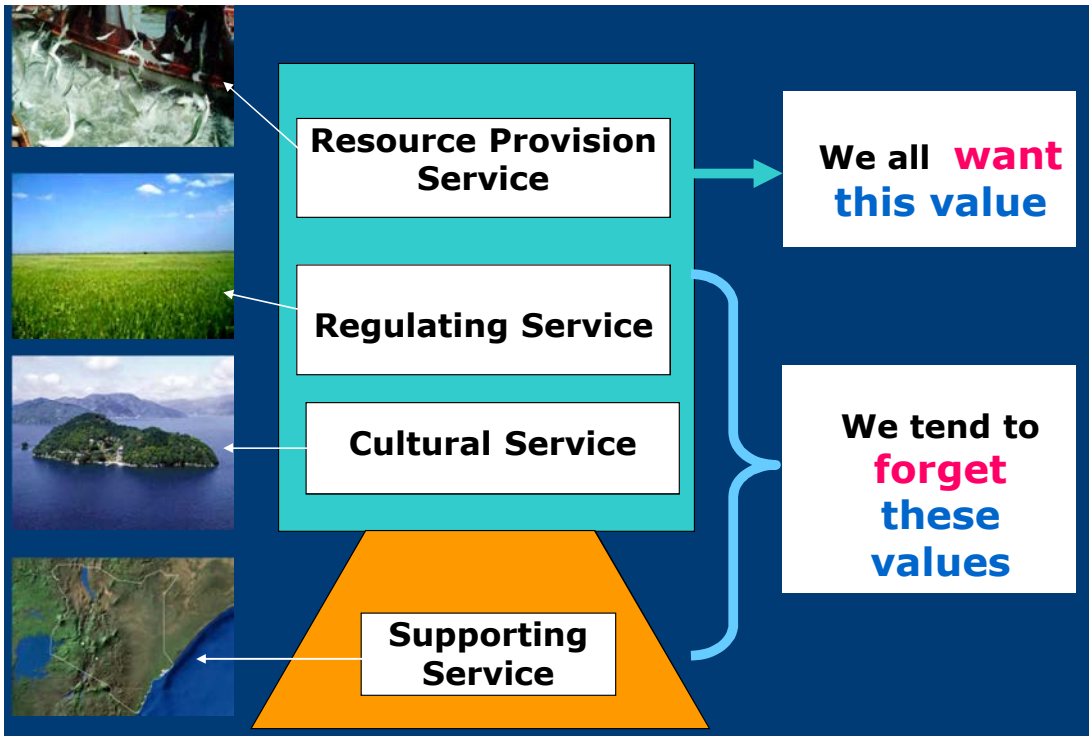
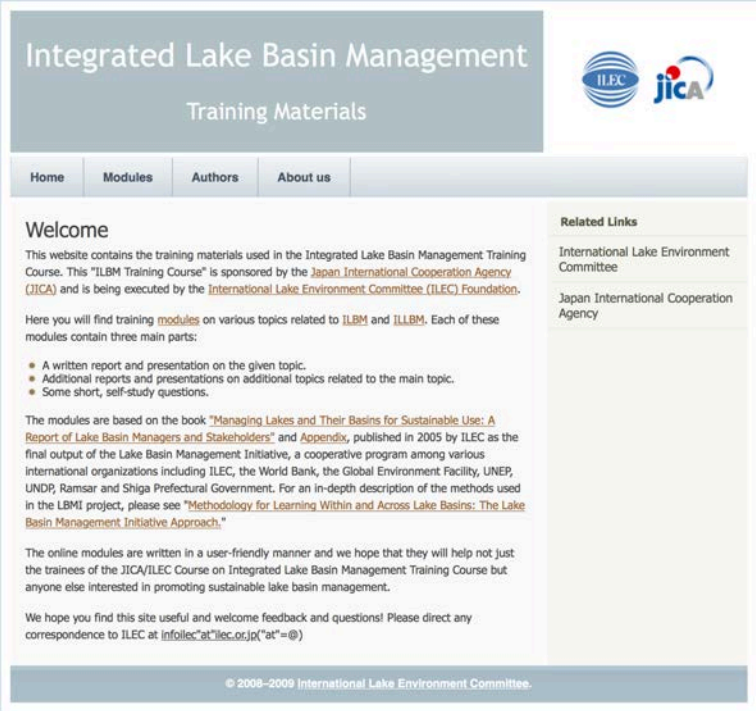
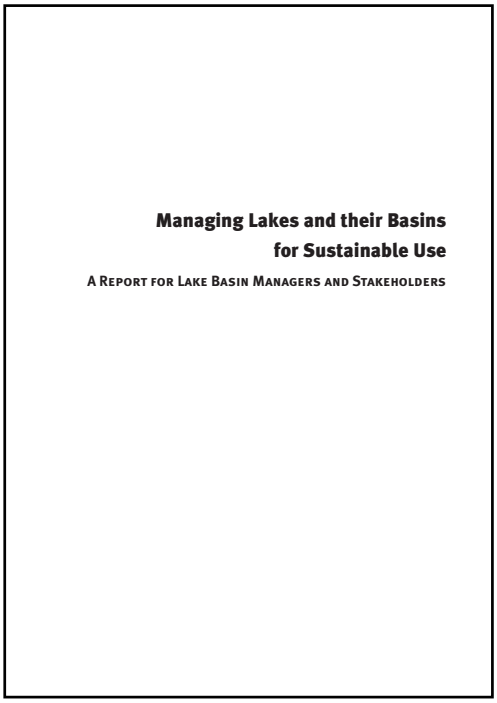
Ecosystem Services



Managing Lakes and their Basins for Sustainable Use





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Watershed Water Quality Risk

- **Watershed Water Quality Risk**
  - *Possibility to threat to social and economic activities and civil life from the viewpoint of water use and public health in river basin*
- **Vulnerability in Qualitative Risk of Water Resources for Water Supply**
  - Raw water contamination caused by an effluent spill out public waters from damaged sewerage and wastewater system located at the upper stream of the river

Watershed Water Quality Risk Management

- **Risk/Crisis Management**
  - Analysis and assessment of risk
  - Development of strategic plan for risk reduction
  - Establishment of countermeasure
  - Improvement of faculties for emergency response through drill and training
- **Establish Watershed Water Quality Risk/Crisis Management as a Watershed Unity**

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Watershed Water Quality Risk/Crisis Management

Establish Watershed Water Quality Risk/ Crisis Management as a Watershed Unity

Evaluation Procedure for Watershed Water Quality Risk Reduction

- **Evaluation Modeling for Watershed Water Quality Risks on Earthquake Disaster**
  - Development of watershed water quality risk scenario
  - Development of watershed flow model
  - Modeling of watershed water quality risk evaluation
- **Evaluation of Risk Reduction on Measures Against Watershed Water Quality Risk**
  - Water quality risk countermeasure were evaluated to determine the extent that each contributes to watershed water quality risk reduction and its mitigation effectiveness

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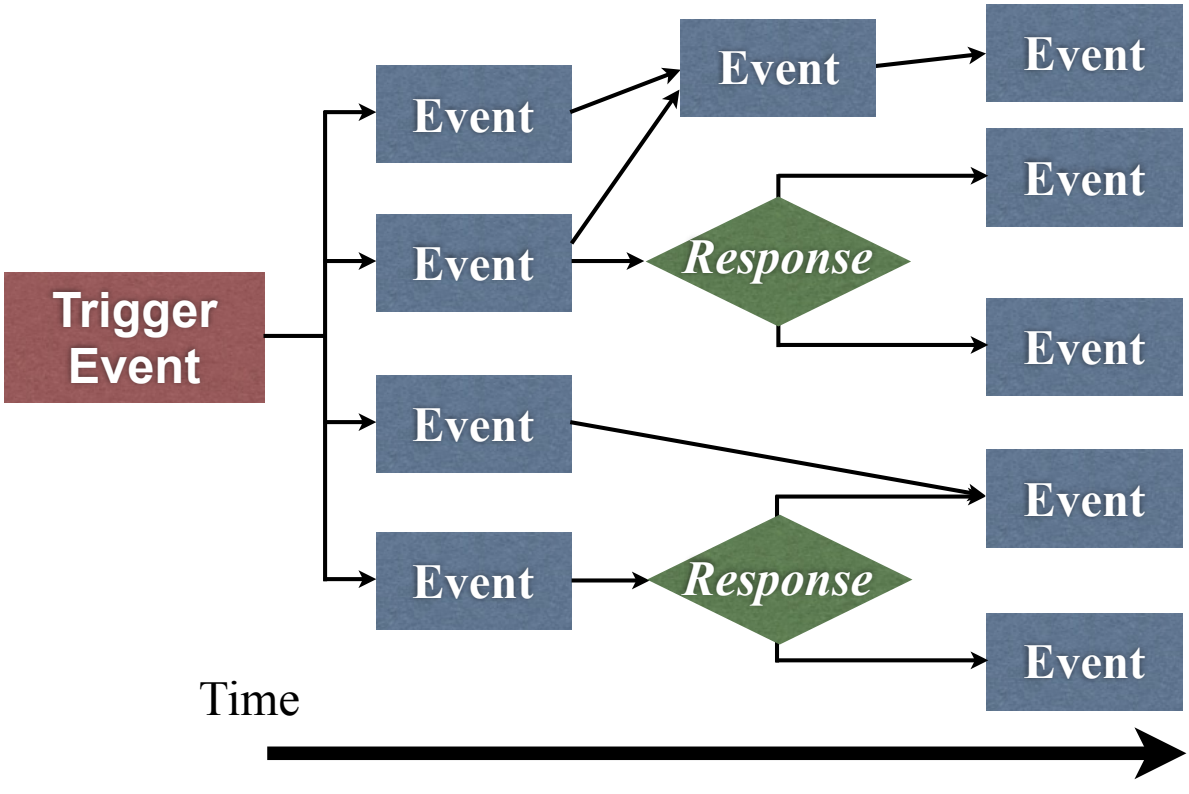
Development of Watershed Water Quality Risk Scenario

- **Scenario Planning**
  - *Strategic planning method*
  - *Multiple visions of the future*
  - *Scenario logic model*
- **Implementation of Workshop for Scenario Planning**
  - *Waterworks*
  - *Sewerage system*
  - *River administrator*
  - *Manufacturing industries*

Biwa Lake and Yodo River and the Kyoto Hanaore Active Faults

Scenario Logic Model Event Tree



Process of Workshops

To construct a decision tree and provide information related to hypothetical damage caused by an earthquake along the Kyoto Hanaore Active faults, which is the subject hazard.

To extract ideas through verbalization on cards.

To group the extracted ideas.

To share the contents of the gourps

To decide whether to use them as scenario drivers for the watershed water quality risk scenario.

To reach consensus among workshop participants.

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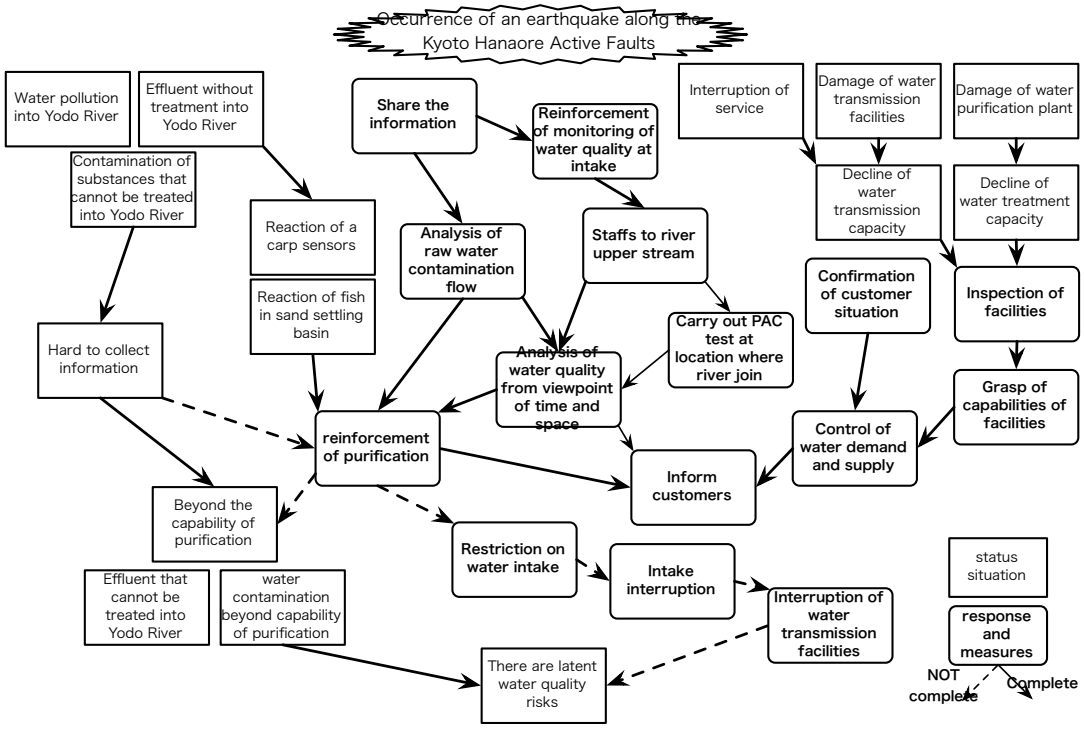
Participation on Workshop

Result of Water Quality Risk Scenario in Water Supply Sector



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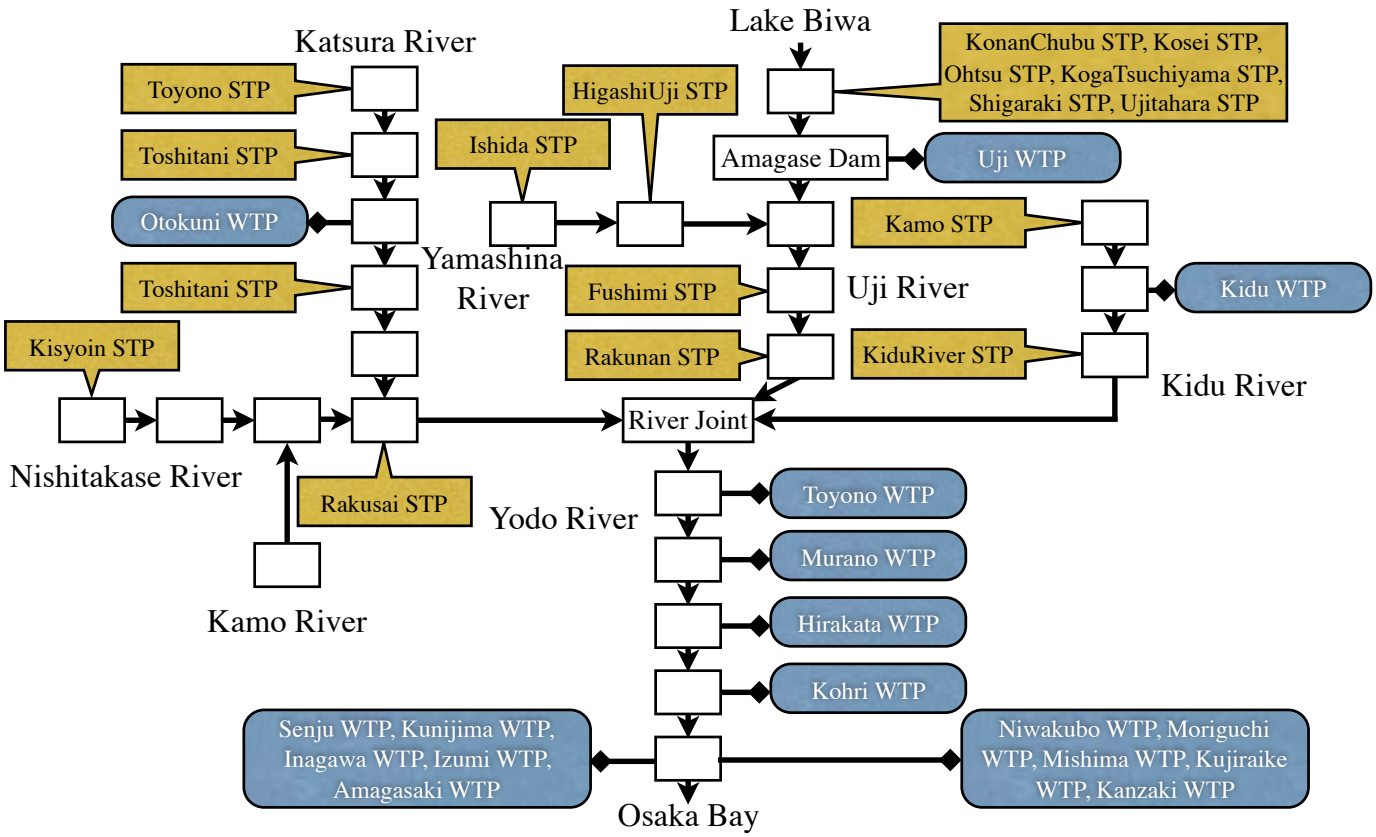
Evaluation of Risk Reduction on Measures Against Watershed Water Quality

- **Water Quality Risk Risk Reduction Effectiveness through Relative Evaluations**
  - *Watershed water quality risk estimation as 100% BEFORE the implementation of water quality risk mitigation countermeasures and policies*
  - *Calculate watershed water quality risk AFTER the implementation as a percentage*
- **Countermeasure on Watershed Water Quality Risk**
  - *To change in the frequency of events*
- **Numerical Simulation with Monte Carlo Method**

Lake Biwa and Yodo River Watershed Flow Model



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Outline of Evaluation Model for Watershed Water Quality Risk

Lake Biwa and Yodo River Watershed Flow Model

Lake Biwa → Yodo River → Osaka Bay

Manufacturing Industries | Sewerage Treatment Plant | Water Treatment Plant

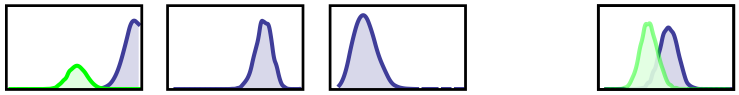
Watershed Water Quality Risk Scenarios

Scenario Logic Model

Scenario drivers → Scenario drivers → Scenario events → Events related Watershed Water Quality Risk

Monte Carlo simulation method

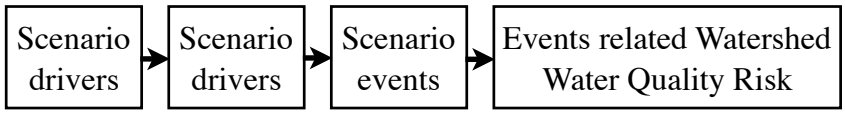
Frequency of occurrence



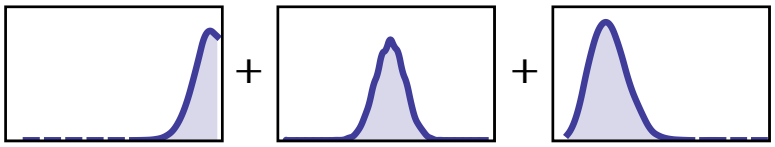
Scenarios of Water Quality Risk Countermeasures : increase/decrease of frequency of occurrence

Monte Carlo Simulation Method for Watershed Water Quality Risk Reduction

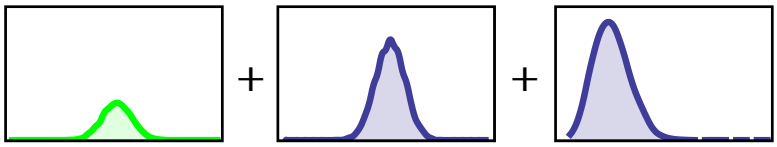
Scenario Logic Model

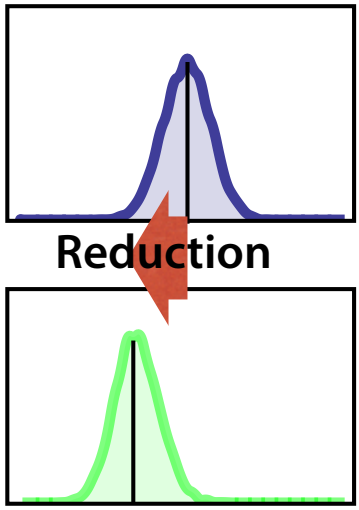


Before Implementation of Countermeasures



After Implementation of Countermeasures





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Frequency of Occurrence of the Scenario Drivers

V	very likely （more than 90%）
IV	likely （65%～90%）
III	medium likelihood （35%～65%）
II	unlikely （10%～35%）
I	very unlikely （less than 10%）

Countermeasures Scenario for Watershed Water Quality Risk Reduction

No.	Content	Manufacture	Sewerage	Water
M1	Prevention of fall of material equipments in manufacturing industries	✓		
M2	Prevention of effluent in manufacturing industries	✓		
S1	Measures on interruption of service in sewerage system		✓	
S2	Preservation of capability of pumping station in sewerage system		✓	
S3	Preservation of capability of sewerage treatment		✓	
S4	Information sharing with stakeholders on river downstream		✓	
W1	Measures on interruption of service in water supply system			✓
W2	Change water intake in water supply system			✓
W3	Intake interruption in water supply system			✓
W4	Preservation of capability of purification facilities in water treatment system			✓
W5	Conduct of powdered activated carbon treatment in water treatment			✓
W6	Suspension of water transmission facilities in water supply system			✓
MA	Comprehensive measures in manufacturing industries (M1 & M2)	✓		
SA	Comprehensive measures in sewerage system (S1, S2, S3, & S4)		✓	
WA1	Countermeasures without quantitative risk measures (W1, W2, W4, & W6)			✓
WA2	Comprehensive measures in water supply (W1, W2, W3, W4, W5, & W6)			✓
ALL1	Cooperative measures without quantitative risk measures (expect W3 &W6)	✓	✓	✓
ALL2	Cooperative measures including quantitative risk measures	✓	✓	✓

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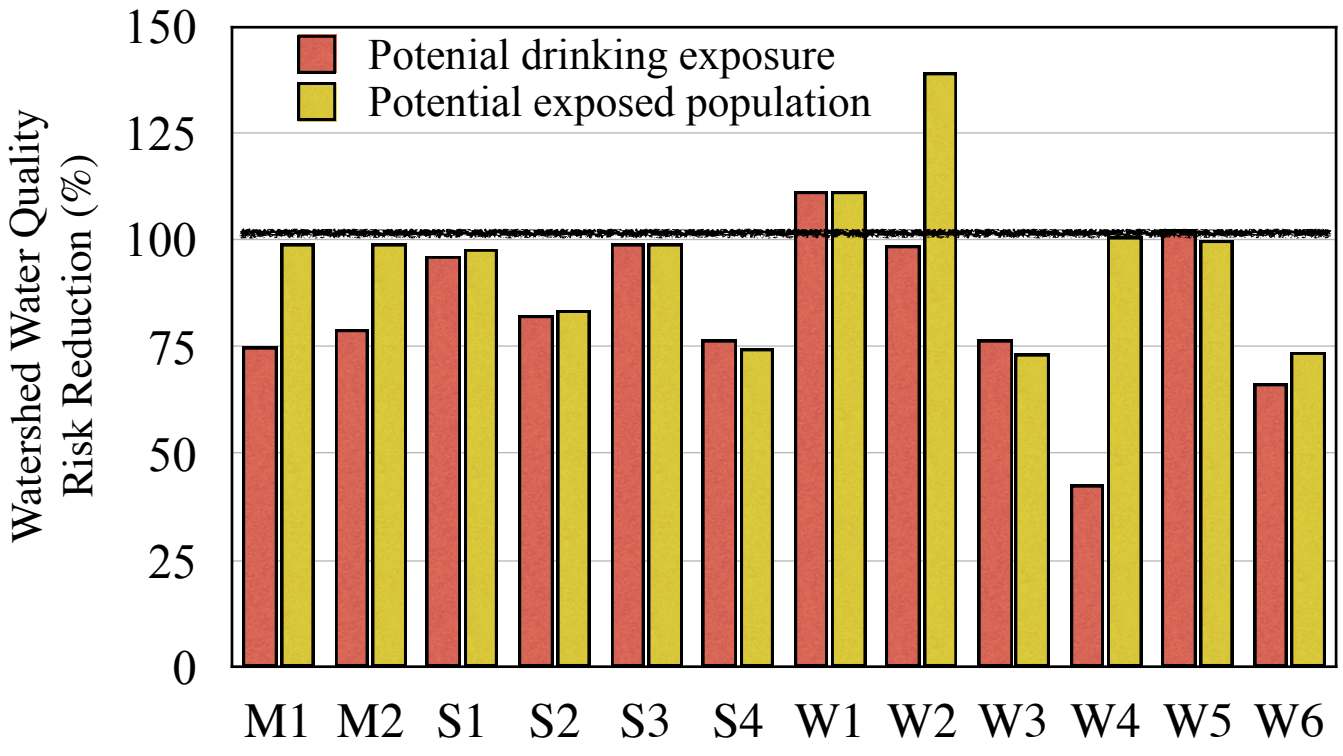
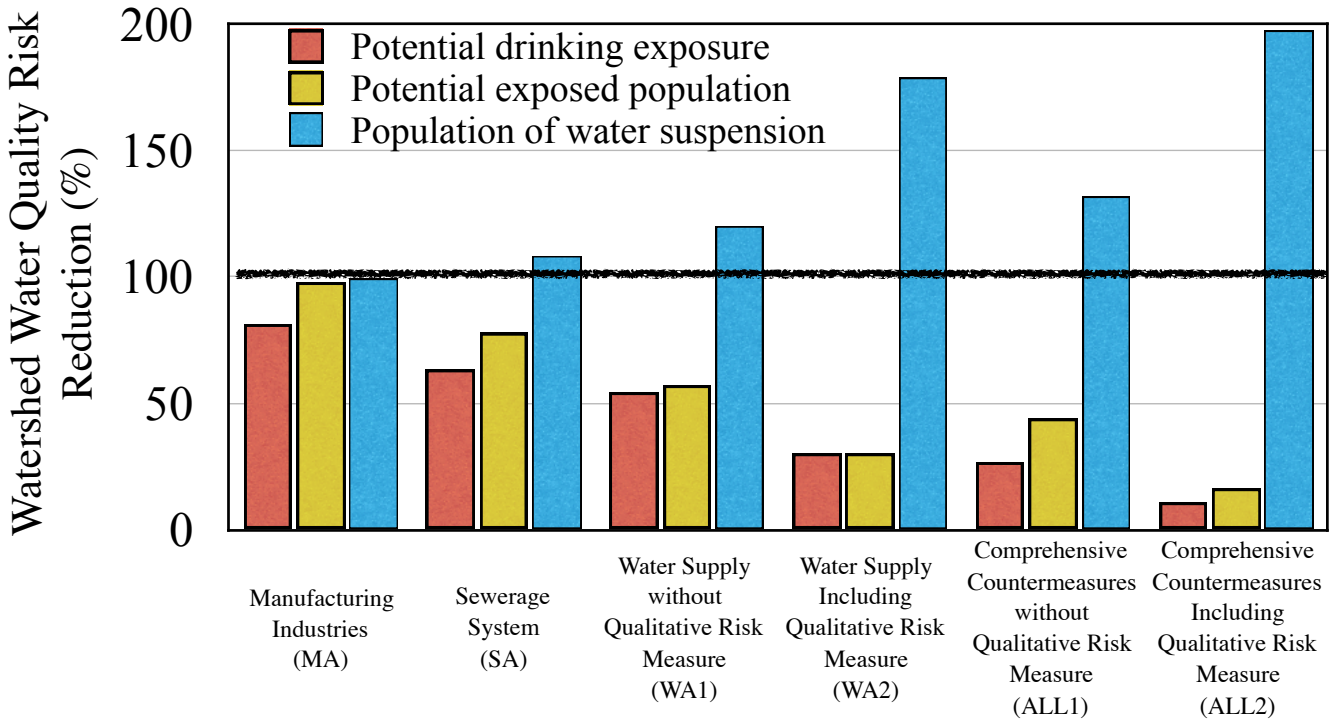
Results of Effectiveness Evaluation of Watershed Water Quality Risk Mitigation



Result of Evaluation of Watershed Water Quality Risk Reduction



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Conclusions

- Risk Scenario of Watershed Water Quality after Earthquake Disasters
- Evaluation of the effectiveness of the countermeasures against watershed water quality risk in the aftermath
- Comprehensive countermeasures with cooperation of stakeholders
- Dilemma between qualitative risk and quantitative risk in measures, policies, and emergency response
- Implementation of the cooperative measures for preservation of watershed water quality for water supply