6th International Forum on Waterfront and Watershed Restoration
29 September 2009 (Asian River Restoration Network)

Flow Regime Restoration in Japan - Past, Present and Future

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Contents

1. River restoration in Japan -Overview-
2. Flow allocation problems (in past)
3. Current rules and regulations on flow alteration
4. Studies for future

1. River restoration in Japan
- Historical context -

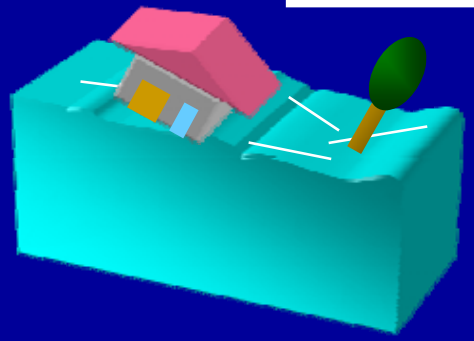
Local management

Navigation
Irrigation

(Old) River Law
1896

River management by Central government

Flood control

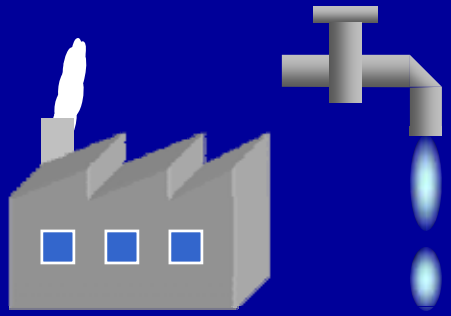


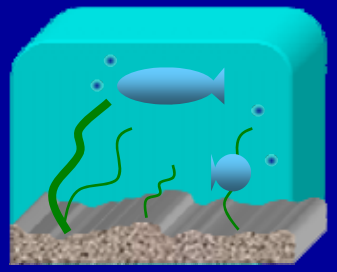
... Industry, Hydropower, Population, ...

(New) River Law
1964

Flood control
+ Water supply

1988 Normal Flow
1990 Nature-Oriented River Works



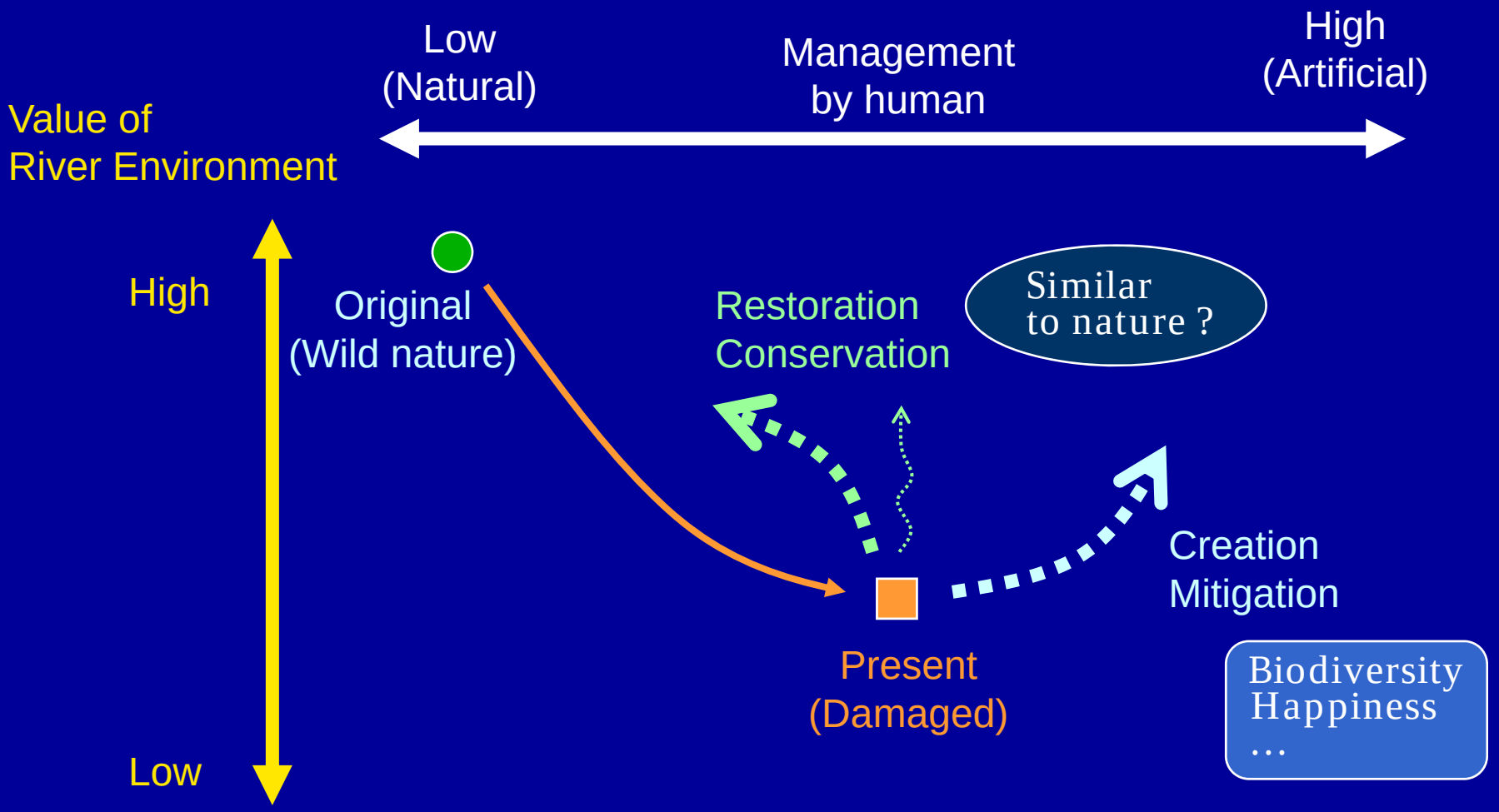


(Amended) River Law
1997

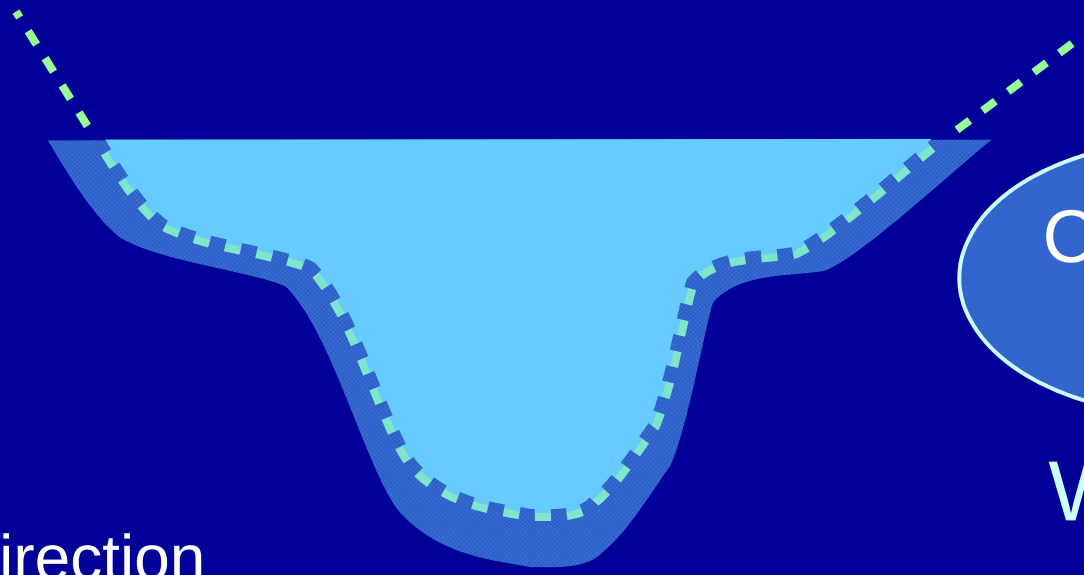
Local involvement

Flood control, Water Supply
+ Environment

Going back or Creation ?



What we can manage ...



Shape / Edge

LAND

- Channel direction
- Revetment works
- Riverside vegetation
- Floodplain management
- …

Contents Flow

WATER

- Flow quantity
- Water quality
- Sediments
- Aquatic lives
- …

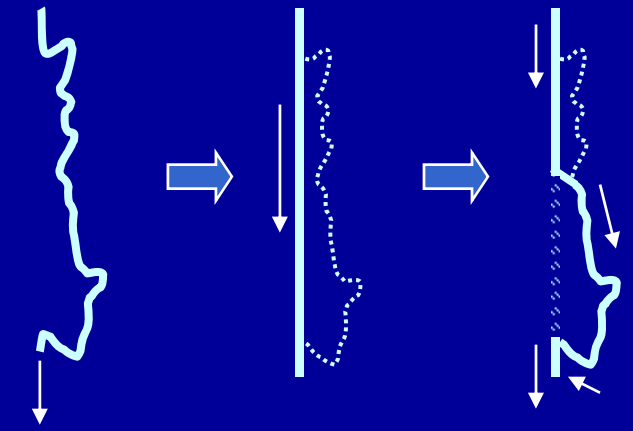
Management categories

	Restoration	Creation
LAND	➢Re-Meander (space for rivers) ➢Alien species ➢Landscape	➢Human-friendly (Urban rivers) ➢Habitat creation (mitigation)
WATER	➢Flow Regime Restoration	➢Normal Flow ➢Flushing Flow

Re-meander Projects

LAND - Restoration

Kayanuma
(Kushiro river)



Original

Meandering
Wetlands

Straight
Cut-off
(1973-84)

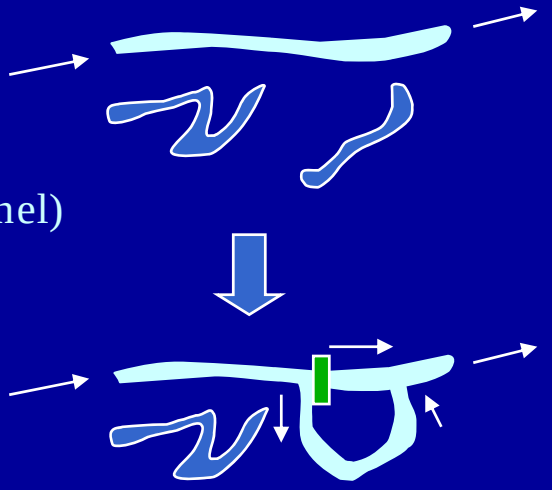
Re-meander
(2006-)

Flood drainage
Farmland development

Shibetsu river

Channelization
(1967)

Oxbows
(Old channel)

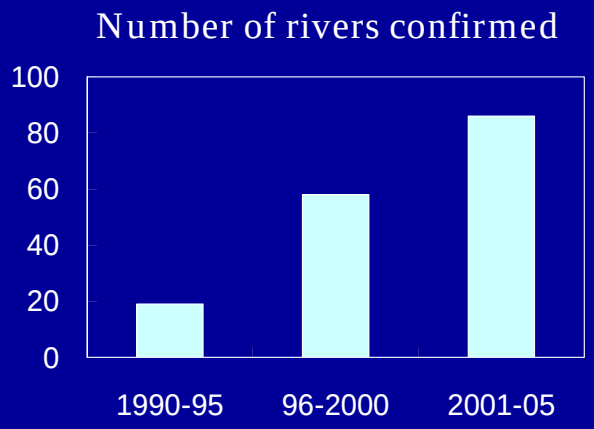


Re-meander
(2002-)

Countermeasures against Alien Species

LAND - Restoration

Black locust
(Robinia pseudoacacia)



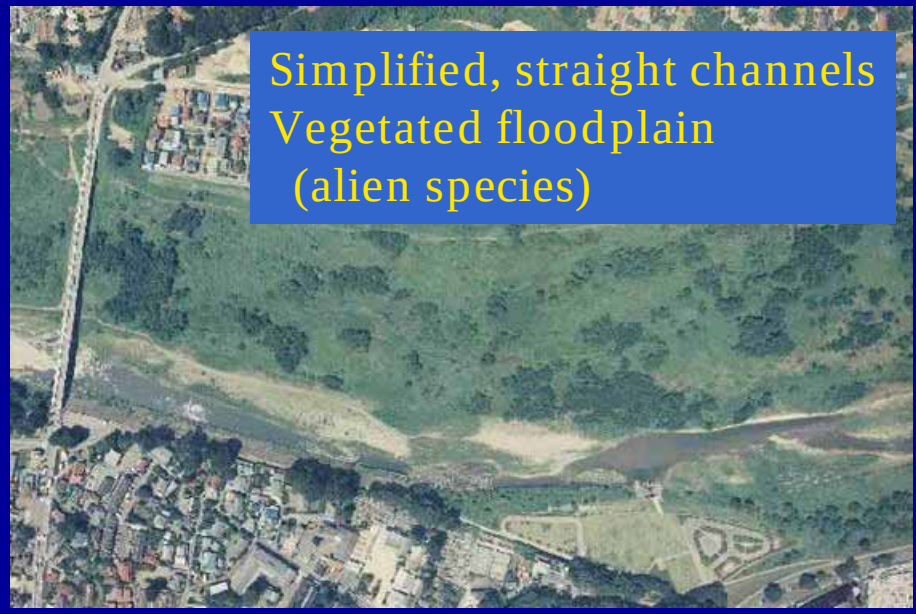
Lance - leaved coreopsis
(Coreopsis lanceolata L.)

Star cucumber
(Sicyos angulatus)

Landscape Restoration

LAND - Restoration

1947 Tama river 1997

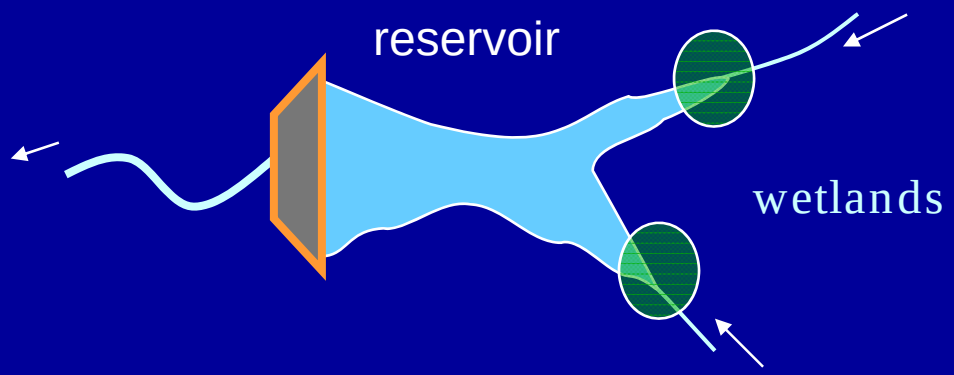


Sand mining
Damming
Flood control (less disturbances)

Vegetation management
Sediment supply
Flow regime control

Habitat Creation

LAND - Creation



Haizuka Dam
(Gonokawa River)

2. Flow allocation problems

- Irrigation <–> Irrigation
  - since ancient times
- Hydropower <-> Fishery, Forestry
  - since 1920s
- Urban use <-> Irrigation
  - 1950s -
- Hydropower <-> Scenery, Local community
  - 1960s -

Conflicts on river flow

Kurobe Dam

Highest Dam in Japan (186m)
Constructed in 1963 …novel, movies
Hydropower (72 m^3/s, 545m)

Located in National Park

Hydropower generation (335MW)

Natural beauty (downstream)
Tourism resource (flow release)

Agreement

10 or 15m^3/s
(6/26-10/15,
6:00-17:30)

Power loss

78 billion MWh

Conflicts on river flow

Sandan Gorge

Agreement

0.4 or 1.0 m^3/s
(5/1-11/15,
morning to evening)

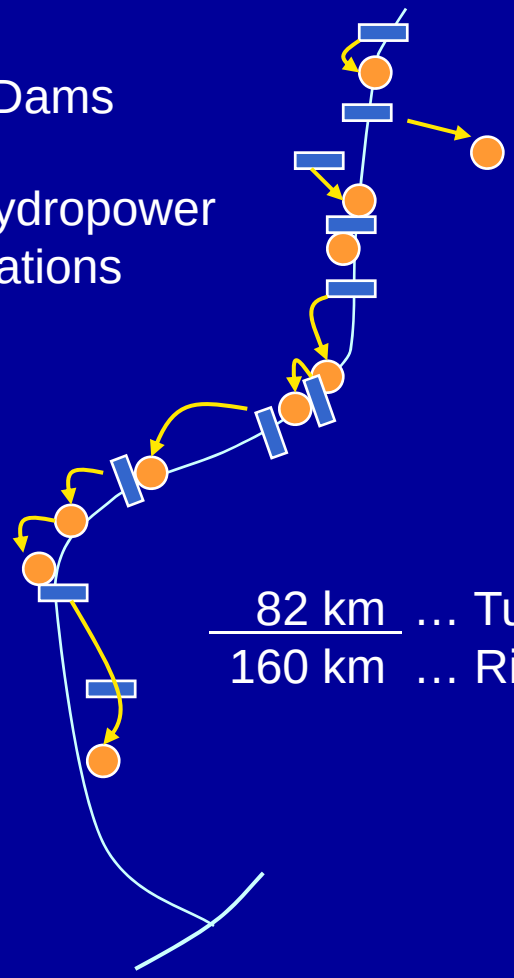
Tarudoko Dam (42m)
Constructed in 1957
Hydropower
(24MW, 7.0m^3/s, 403m)

Conflicts on river flow

Oi River

Dams

Hydropower stations



82 km … Tunnel

160 km … River

"River Desert" "Get back the water"

1975 Request for flow releases (local gov.)
1977 0.5m^3/s release from Shiogo dam
1988 3.0m^3/s release
1989 5.0m^3/s release (3/20-12/5)

Conflicts on river flow

Tama River

Hamura weir
(1653)

1936

2.0 m^3/s
(5/20 - 9/20)

requests
(1982,86,89)

1992

2.0 m^3/s
(throughout a year)

Municipal water

Water quality
Landscape

3. Current rules and regulations on flow alteration

- “Normal Flow” concept
- Government notice 1988
- Estimation guideline
- Flushing flow experiments

“Normal Flow” concept

- River Law (1964, amended in 1997) says in its “Article 1”:
  - The purpose of this Law is to contribute to land conservation and the development of the country, and thereby maintain public security and promote public welfare, by administering rivers comprehensively to prevent occurrence of damage due to floods, high tides, etc., utilize rivers properly, maintain the normal functions of the river water by maintaining and conserving the fluvial environment.

    (Article 1: Purposes)

- “Normal flow” should be secured before water allocation among other users, in all water resources projects. ... in principle.

- But actually, it was neglected or underestimated because no one knew why it is needed... *what is the “normal functions of the river water”?*

Flow maintenance rule in hydropower stations

- Government notice in 1988
  - Environmental flow release from hydropower stations
  - Request in water right permission

- $0.1\text{-}0.3 m^3/s/100 km^2$ (reference standard)

- Single value all over the country, throughout a year ("minimum flow")
  - Must be improved (regional difference, flow fluctuation)

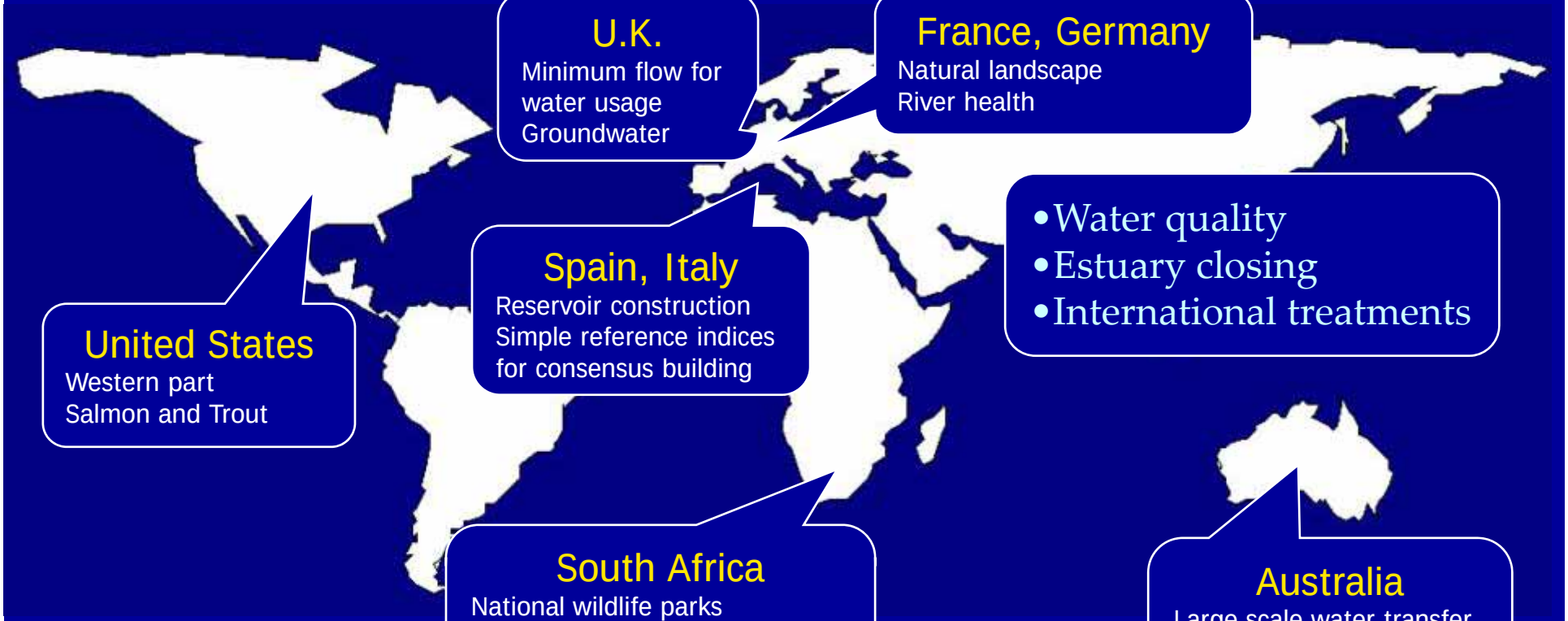
“Normal Flow” estimation guideline (1992)

1. Water quality
   - BOD estimation
2. Scenery
   - Water width, River width
3. Ecosystem
   - Select key species (usually fish, typical species + local fish)
   - Water depth & Velocity suitable for each life stage, each season
4. Navigation, Fishery, Saltwater intrusion, Estuary closing, Groundwater table, Protection of river management works made of woods
5. Existing water rights

Flushing flow experiments

- Ministry of Land, Infrastructure, Transport and Tourism (1997-)
- “Flexible dam operation” for downstream environmental restoration

Environmental Flow around the World



U.K.
Minimum flow for water usage
Groundwater

France, Germany
Natural landscape
River health

- Water quality
- Estuary closing
- International treatments

United States
Western part
Salmon and Trout

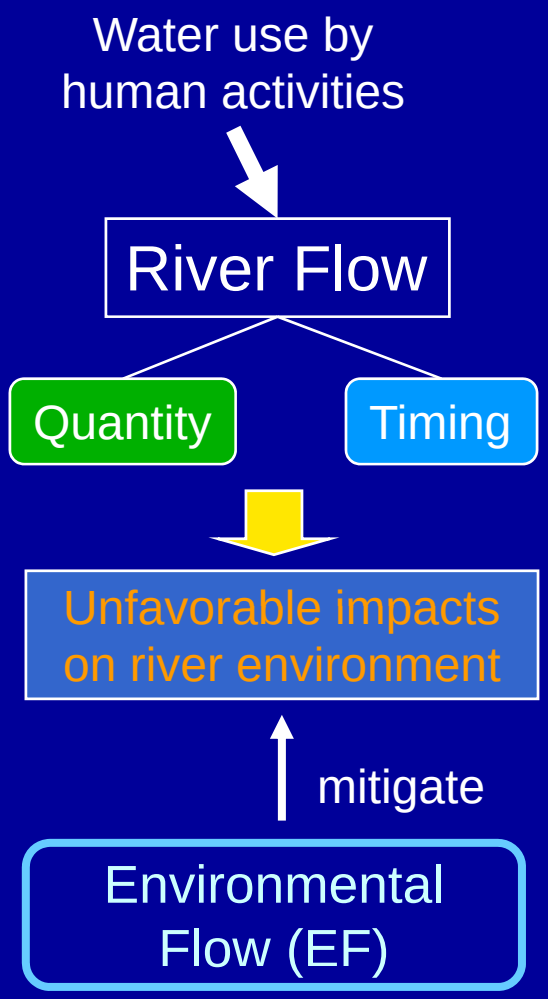
Spain, Italy
Reservoir construction
Simple reference indices for consensus building

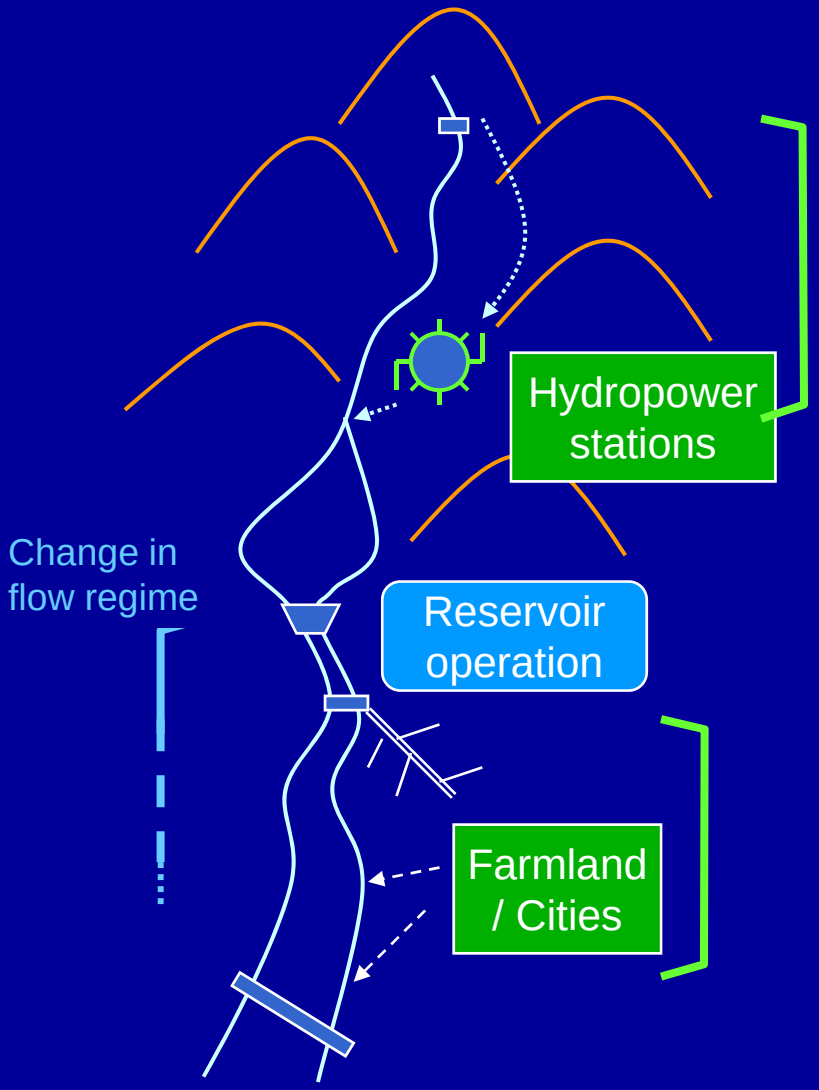
South Africa
National wildlife parks
Water supply for poor people
Decision making under limited information

Australia
Large scale water transfer
Land use change
(Semi) Arid regions
Lowland large rivers

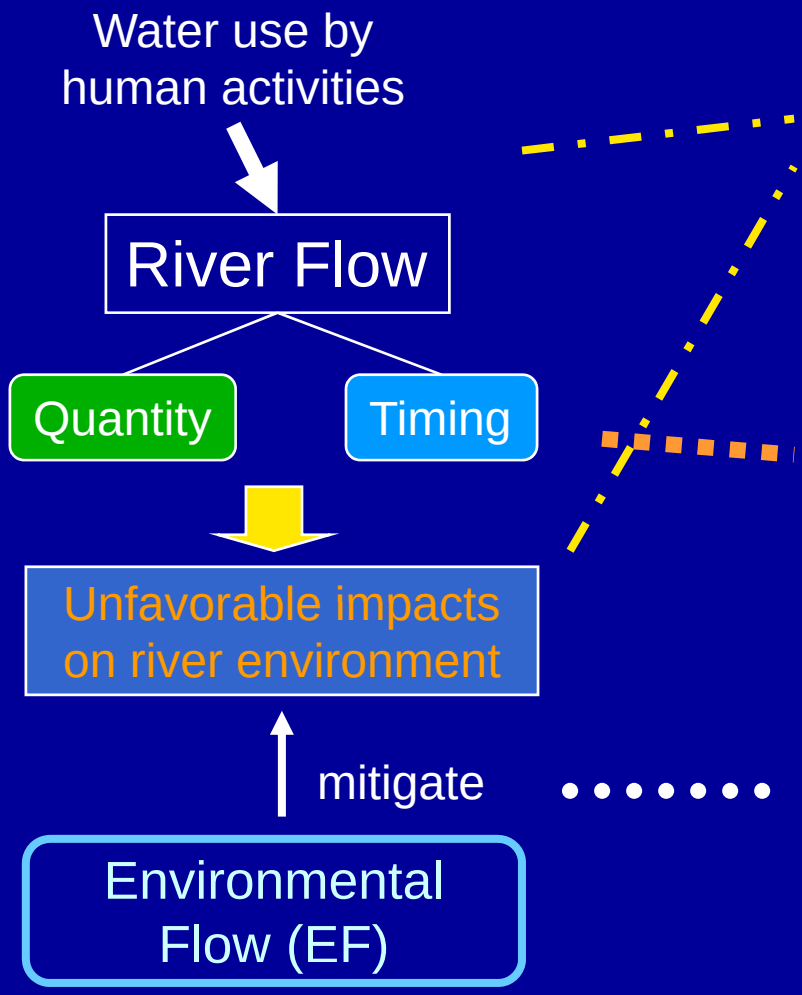
→ **Regional situations** (Social conditions)

4. Studies for future





Studies for future



1) What is the impact?
   - Physical / Ecological
   - Identify / Index

2) Flow variation
   - What does it mean?
   - Identify / Index

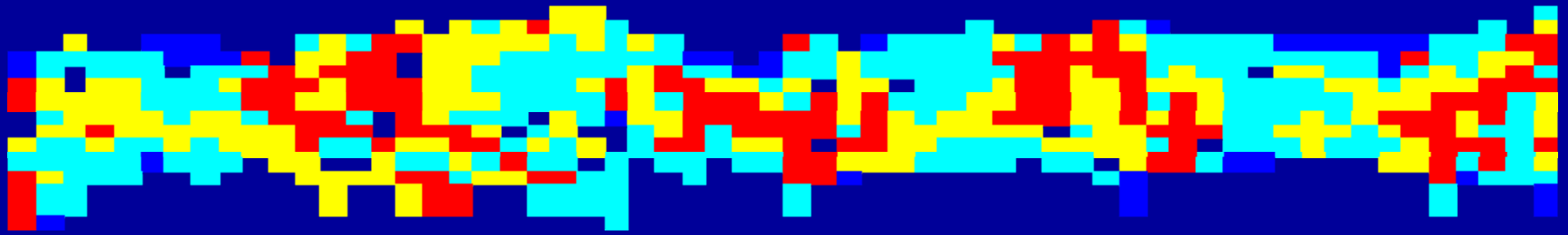
3) How can we evaluate it?
   - Conceptual
   - Cost efficiency

What is the impact?

Dry section

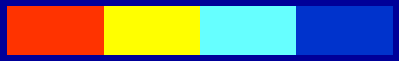
Natural section

Natural section



Dry section

riffle pool

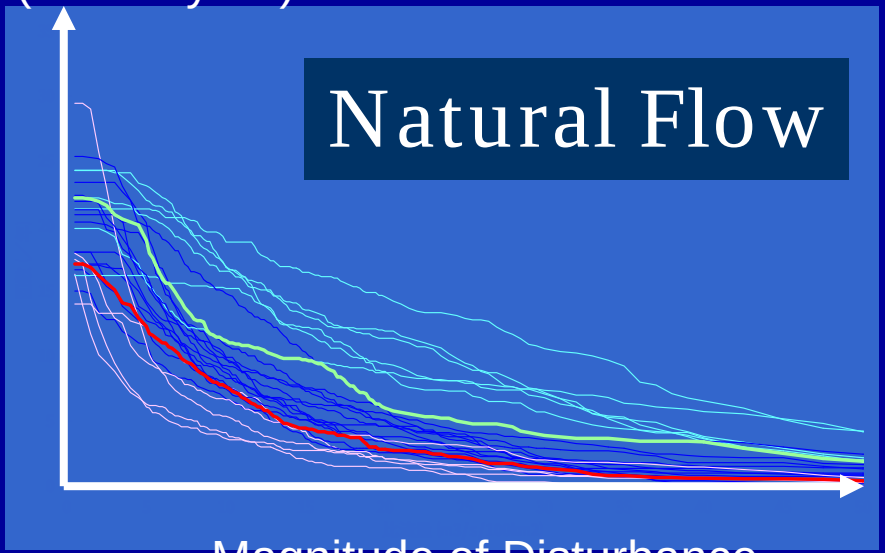


(Sato, 2007)

Flow Variation

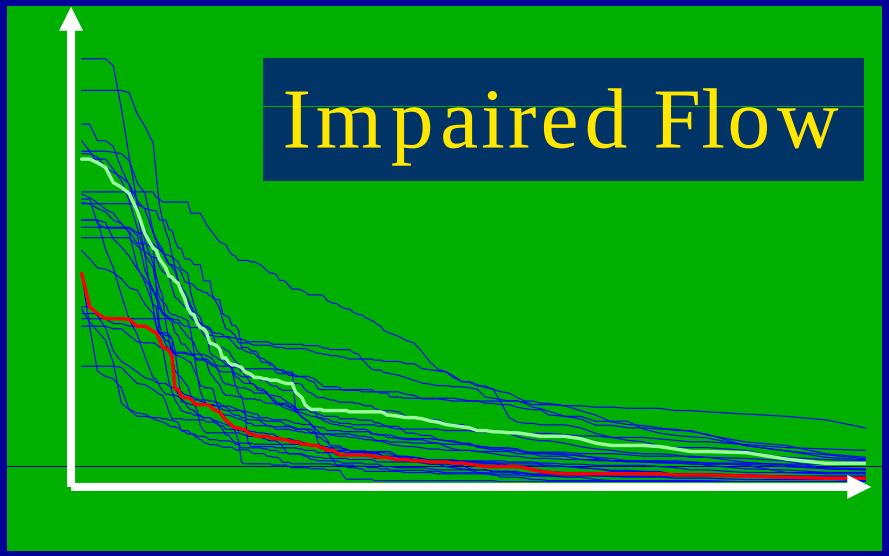
Disturbance Regime Curve Analysis

Frequency
(times / year)



Magnitude of Disturbance
($m^3/s/100km^2$)

Less occurrence for
Medium size disturbance
($10m^3/s/100km^2$: 7-11 /year -> 4-9 /year)



(Shirakawa, 2007)

Evaluation

- Use Values (...resources, spaces)
  - Environmental Economics
  - Limited but sophisticated
- Existence Values (feeling, be happy)
  - Questionnaire ?
  - Can we realize all the values correctly?
- Supporting Values (Ecosystem)
  - Not predictable (especially in Monsoon Asia)
  - Consensus building, discussion


Thank you !