Hierarchical Watershed Management

- Bridging the stakeholders dispersed over the different spatial levels-

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Rice field and local communities in the East of Lake Biwa

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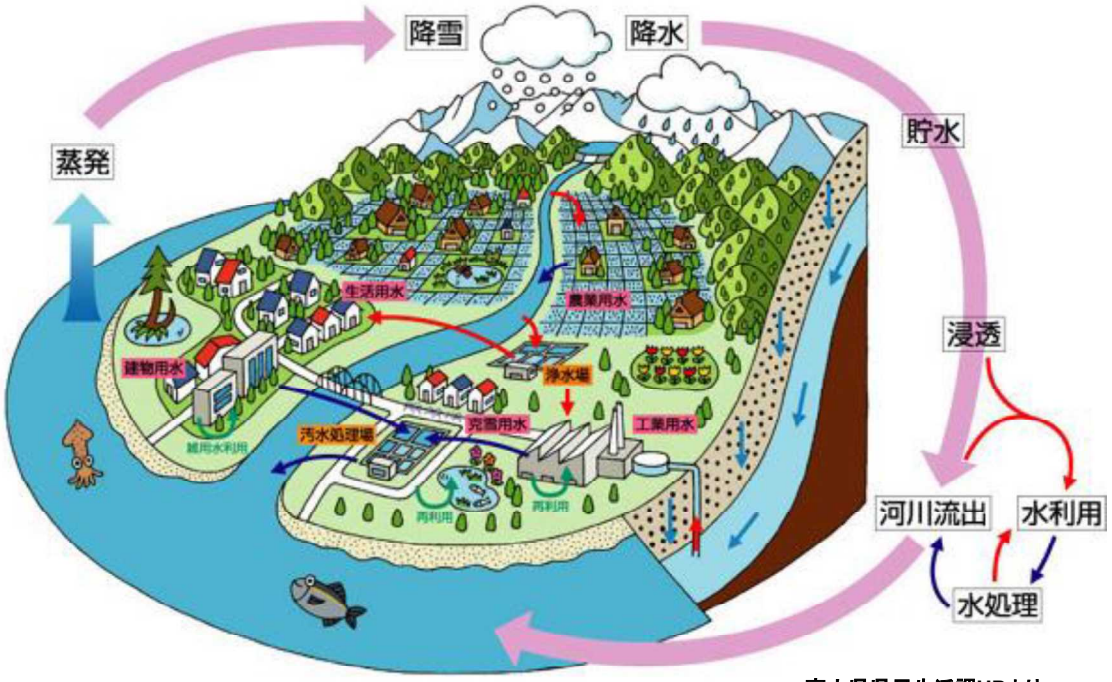
On watershed management

- **Why watershed management ? *and* why difficult?**
- **Agricultural turbidity problem in Lake Biwa**
  - Non-point source -
- **Communication design for watershed governance**

Why watershed management recommended?

→ *Spatial unit* of water and material cycling!

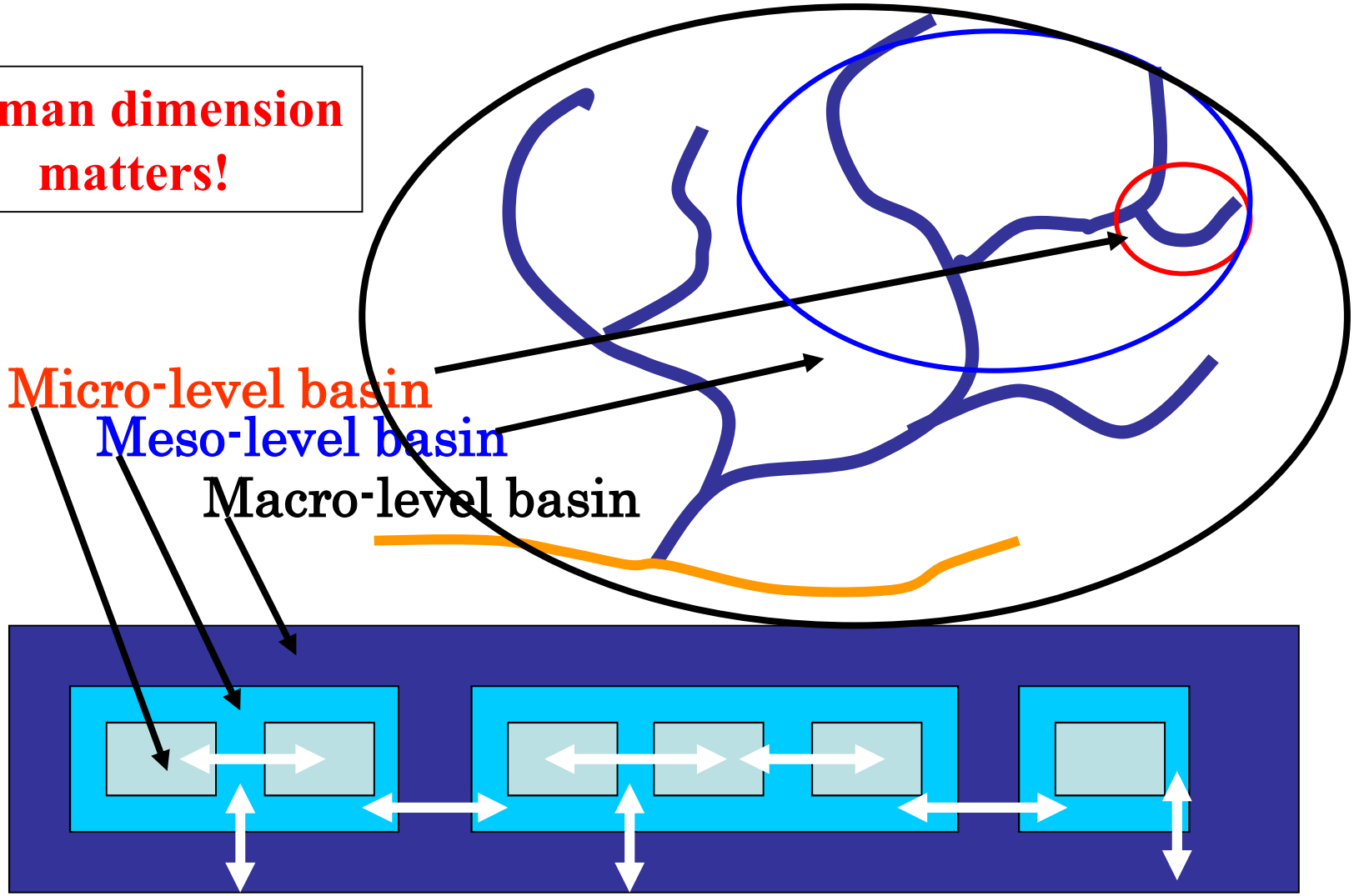


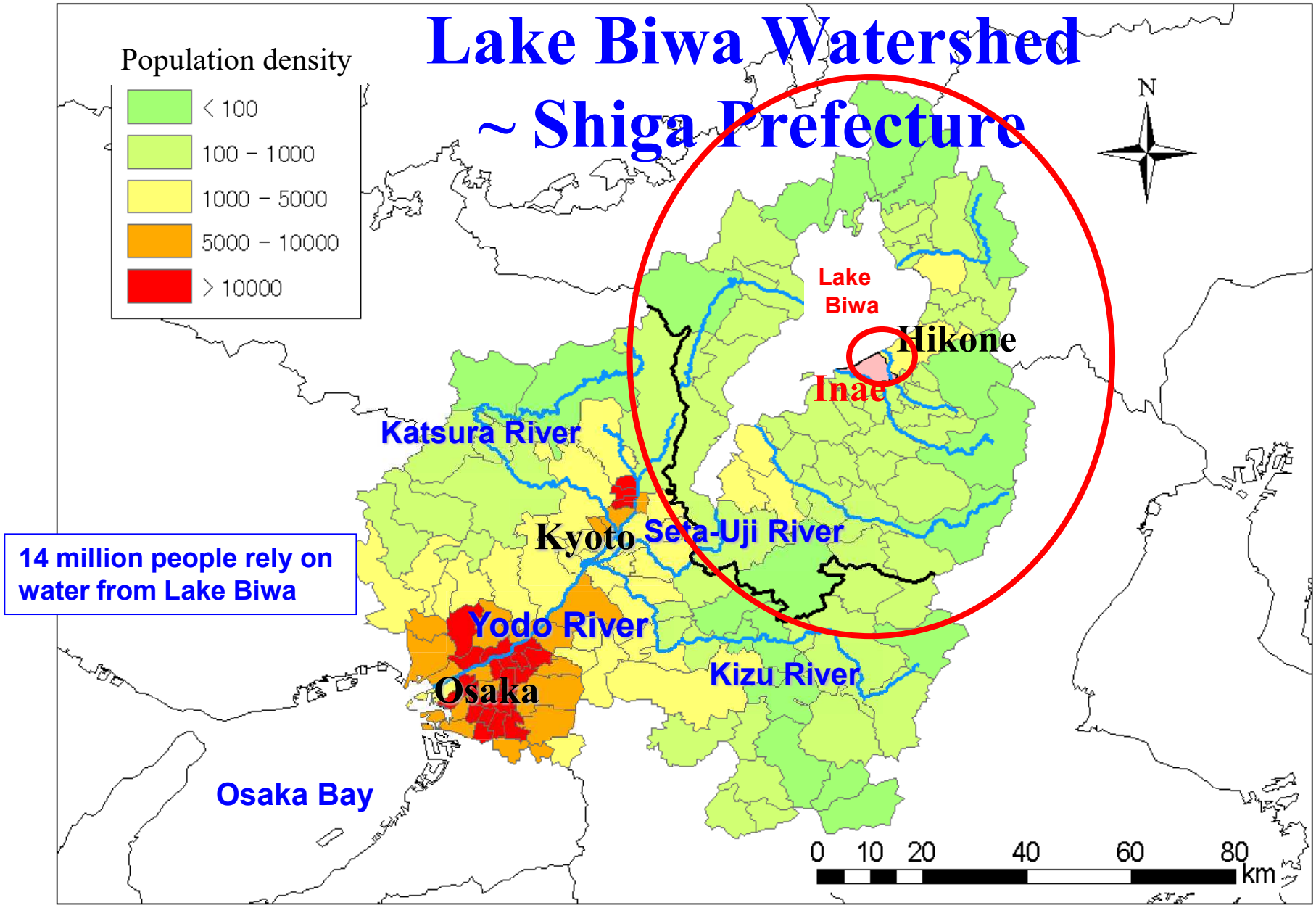
富山県県民生活課HPより

But, watershed has a *nested structure*

Stakeholders dispersed over the watershed

Human dimension matters!




Lake Biwa Watershed
~ Shiga Prefecture
Population density
< 100
100 - 1000
1000 - 5000
5000 - 10000
> 10000
N
Lake Biwa
Hikone
Inae
Katsura River
Kyoto
Seta-Uji River
Yodo River
Kizu River
Osaka
Osaka Bay
14 million people rely on water from Lake Biwa
0 10 20 40 60 80
km

Rich Fish species in Lake Biwa

World 3rd ancient lake!

About 50 species,
More than 10 native species

People in Shiga enjoy lake fish

Agricultural Turbidity Problem in Lake Biwa

Watershed Governance Project at RIHN (2002-2006)

E-01 (CR2)

Ecosophy

Project Homepage ● http://www.chikyu.ac.jp/biwayodo/index.html

Multi-Disciplinary Research for Understanding Interactions between Humans and Nature in the Lake Biwa-Yodo River Watershed

The differences in problem consciousness among various stakeholders occurring from "hierarchy" of a watershed could be a major hindrance to governance, leading to conflicts between top-down and bottom-up Management. We proposed a system of "hierarchical watershed management" to overcome the restrictions derived from these hierarchical characteristics (Figure). Based on this idea, we conducted research on the agricultural turbidity problem in the Lake Biwa watershed to develop a methodology for environmental diagnosis and consensus building with an emphasis on communication. Our project is unique in 1) developing a new methodology to promote governance and participation of residents by 2) our transdisciplinary approach to natural science and social science 3) practiced in three scales in the Lake Biwa watershed (Shiga prefecture as macroscale, Inae district as mesoscale, local communities in Inae district as microscale, 4) moving towards practical watershed and global environmental studies.

Project Leader ■ YACHI, Shigeo Center for Ecological Research, Kyoto University (RIHN until March 2008)

Specific Research Findings

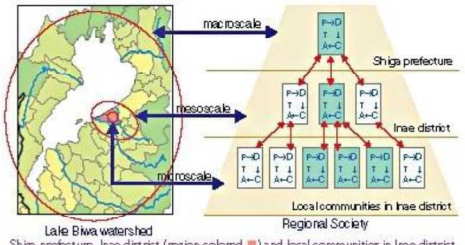
(1) A new watershed diagnosis method revealing the relationship between Lake Biwa and its rivers

The results of newly developed watershed diagnosis methods including stable isotope ratios and rare elements indicate that agricultural activities related to smaller rivers flowing into the eastern part of the lake have a large potential impact on the water quality and eutrophication of Lake Biwa, and that fine-tuned water management and water channel cleaning by local residents through a bottom-up approach is both effective and necessary for the environmental preservation of Lake Biwa.

(2) Clarification of an integrated picture of the agricultural turbid water problem and establishment of a communication methodology to support local residents' voluntary environmental preservation activities

In the background of the agricultural drainage issue, lies a drastic change of Japan's agricultural policy and agricultural community structure, which caused an increase in part-time farmers and decrease in young farmers. A workshop method was developed to support residents themselves discussing the local water environment and its future prospects using maps. Practical workshops were held to confirm how the provision of information related to the current status of the water environment or measures for water environmental preservation would affect the farmers' awareness of environmental considerations or their actions. These results indicate the need to develop a communication method based on the assumption of the individuality of the community and the importance of conditions such as social capital that allow such a method to work effectively.

Figure Hierarchical Watershed Management System Applied to Lake Biwa Watershed in the Case of Agricultural Turbidity Problem



Shiga prefecture, Inae district (region colored ■) and local communities in Inae district indicated by red circles (left) and green boxes (right) are regional stakeholders concerning the agricultural turbid water problem, however, their consciousness of the problem is not the same. The hierarchical watershed management system is a mechanism to promote watershed management by governance of the various stakeholders in the region by building 1) feedback mechanism (PDCA cycle) consisting of monitoring with diagnosis indicators at each scale, and 2) mechanisms to promote communication between hierarchies (indicated by red arrows).

Contributions to Global Environmental Studies

There are two important issues that must be dealt with if we are to solve global environmental problems: (1) a watershed area is important in terms of scale. Dealing with it not only solves regional environmental problems but also constitutes a test bed for specific solutions to global environmental problems; and (2) It is essential to appropriately coordinate various stakeholders with various patterns of involvement in the environment that are deeply rooted in the area. Although this project has the methodology for watershed management as its main theme, we believe the project provided a prototype methodology which can contribute to the way we consider and solve global environmental problems.

Communication of Research Findings

The project final report (in Japanese, ISBN 978-4-902325-11-9) is now available at University libraries in Japan and at the libraries of cities and towns in the Shiga prefecture. In it, 5-year transdisciplinary research on watershed management is compiled as a first step to "watershed environmental studies" with close connection to global environmental problems. Readers will find not only the new research findings but also the message and dynamism of the project emphasizing the importance of practice in regional societies, the social meaning of transdisciplinary collaboration, d academic and social issues to be challenged.

RIHN

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Agricultural Turbid Water Problem: 1980's

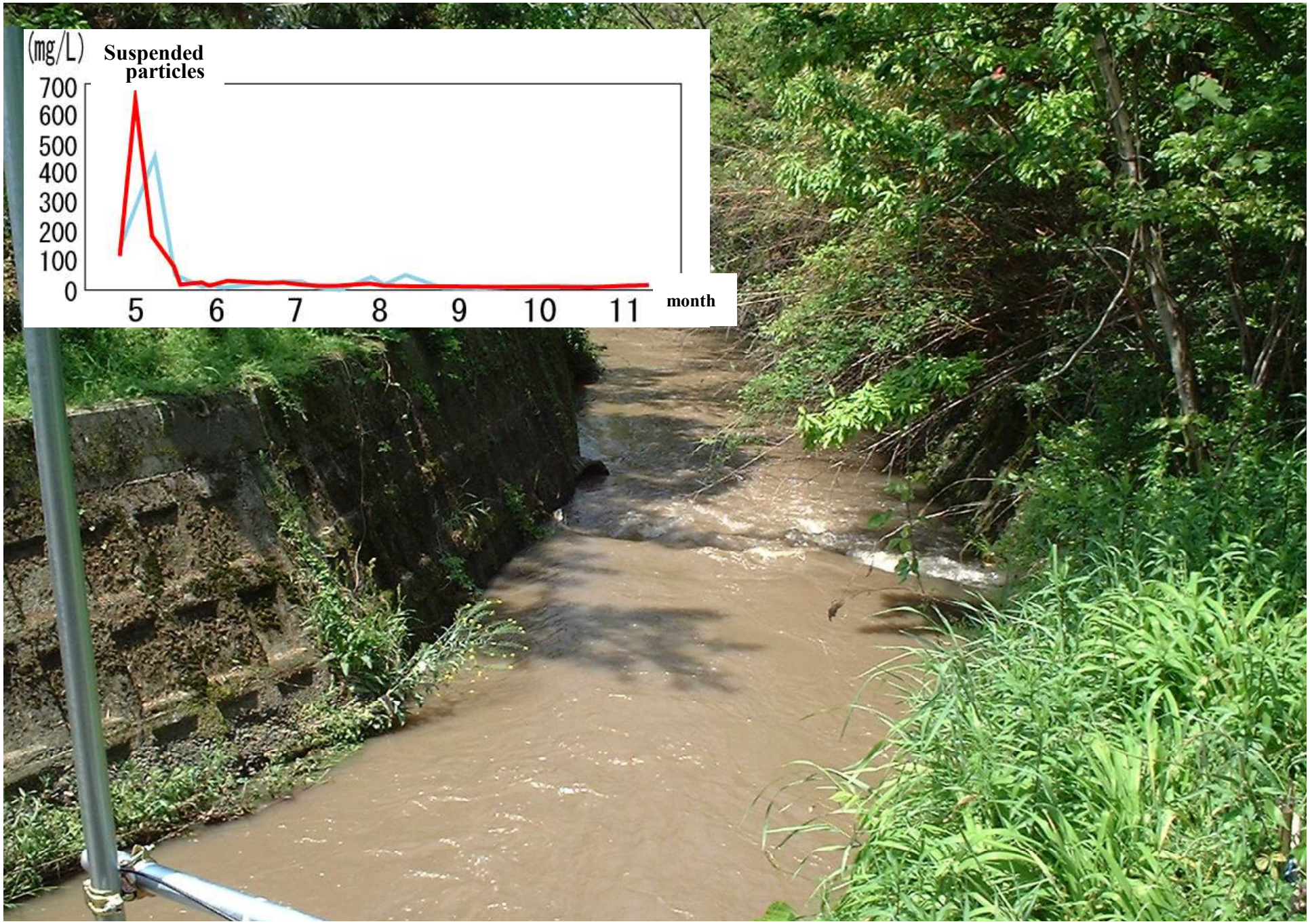
- Non-Point Source-

Soil paddling before rice planting

Lake Biwa

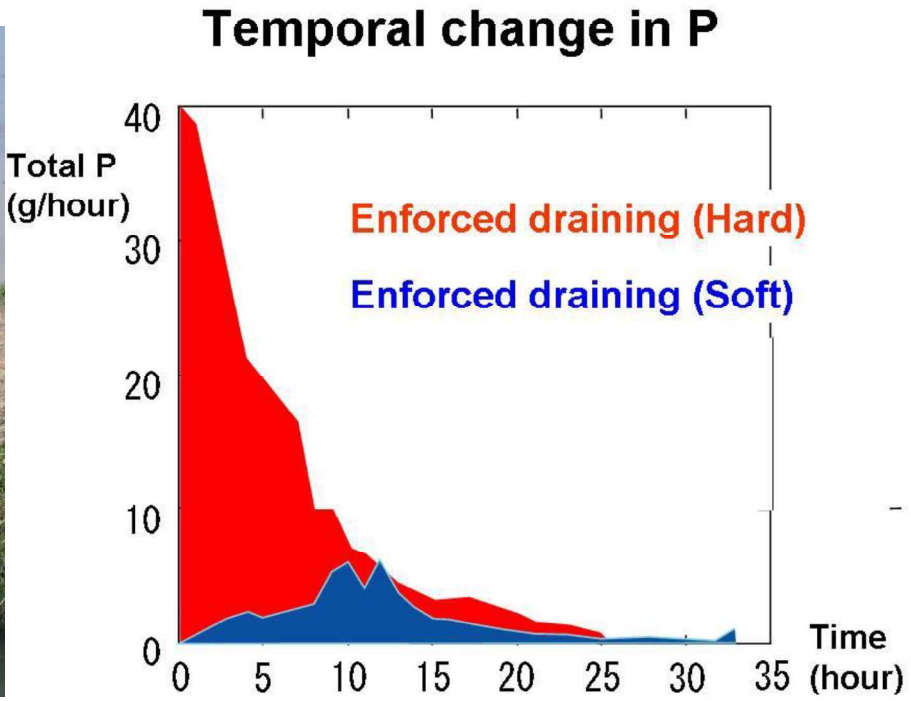
Enforced draining

Small rivers in local communities



Peak of suspended particles in the plowing season

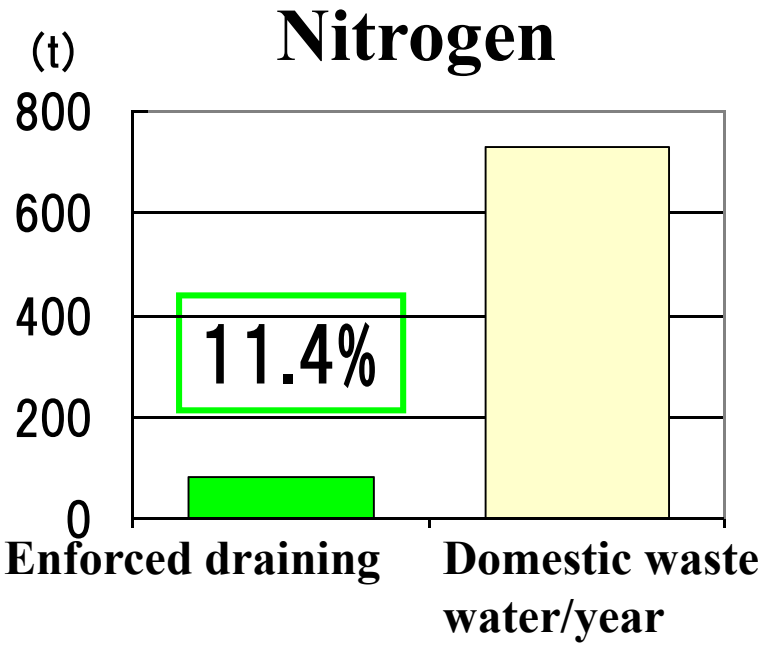
Experiments to evaluate the impact of enforced draining

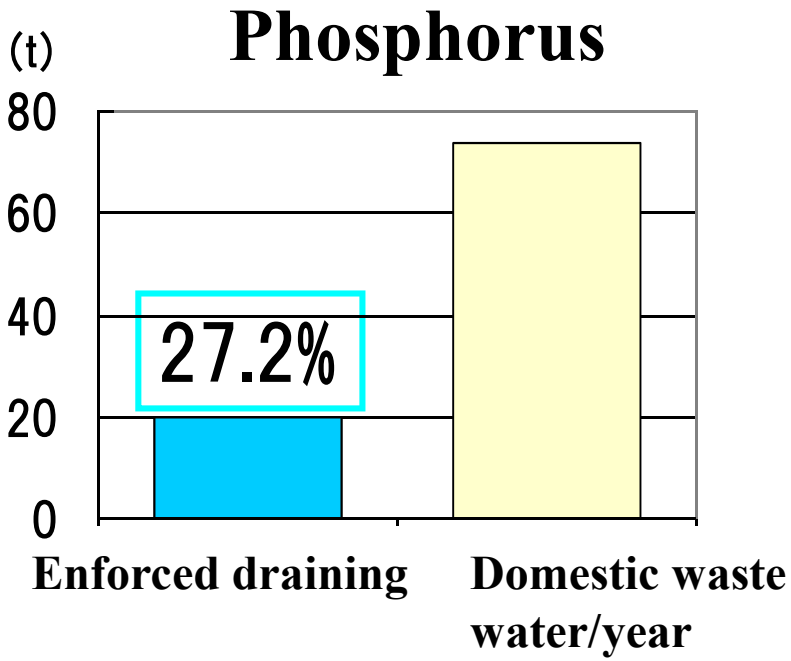


Relative impact of turbid water evaluated at the North Basin watershed

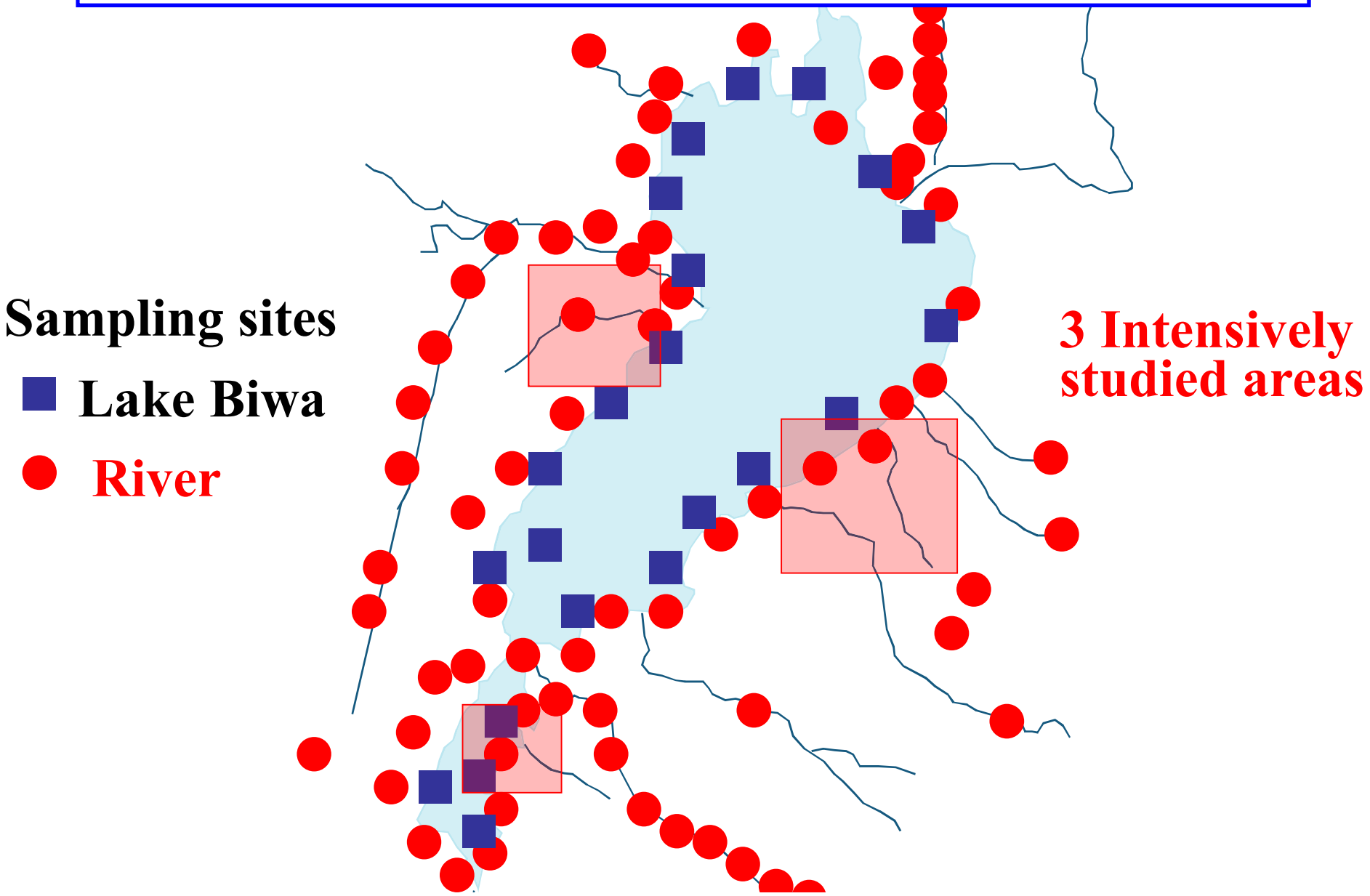
Discharge

Soil：16,100 ton　N：83.2 ton　P：20.1 ton

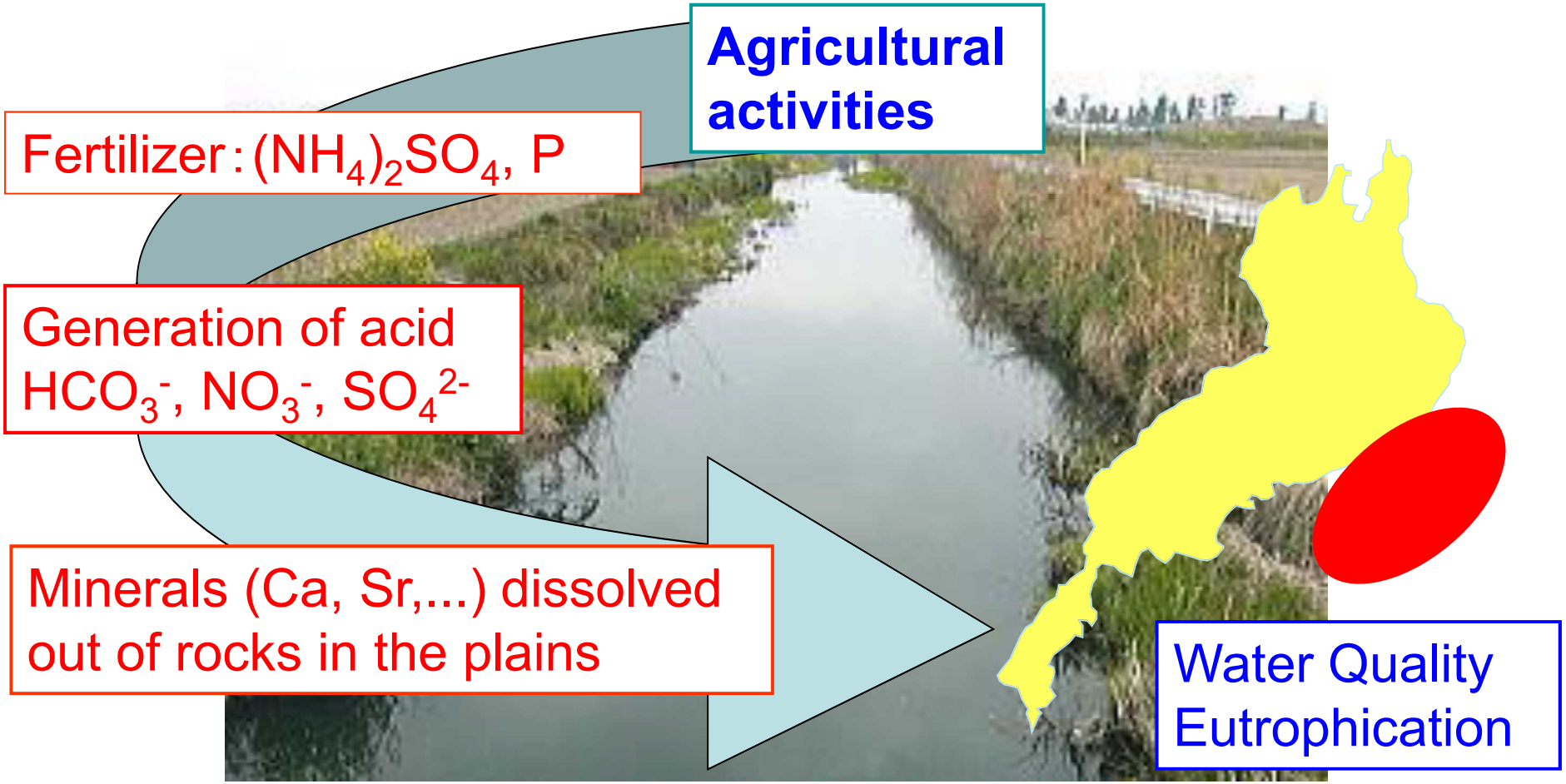




Watershed Diagnosis using *multi-isotopes* and *multi-elements*



Impact of small to medium-sized rivers in the east of Lake Biwa
- A Scientific Scenario -



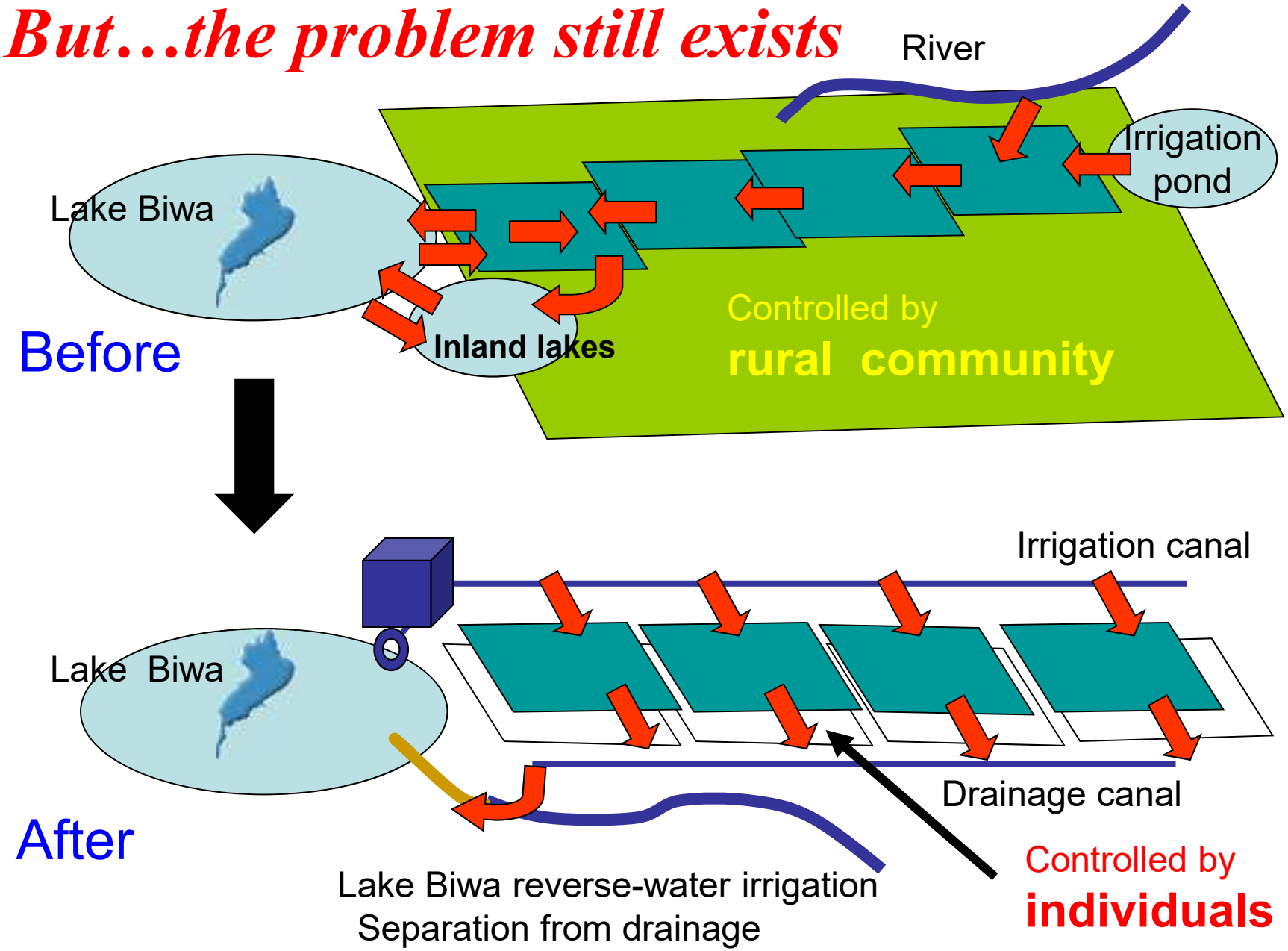
Turbid water problems as *Combined Problems*

Level	 Macro	 Meso	 Micro
Major Problem	Water Quality Regime Shift	Fishery Damage	Deterioration of waterside
Area	Lake BIWA	Lake shore	Canal
Causing	Load from land	Farming household	Farming household
Suffering	Lake water user	Fishery household	Farming household
Material	DO, N, P	SS (Suspended substances)	SS, Mud
Distance	Long	Middle	Short
Time scale	Long	Middle	Short
Type	Global Warming	Causing/Suffering Separation	Self-Feedback

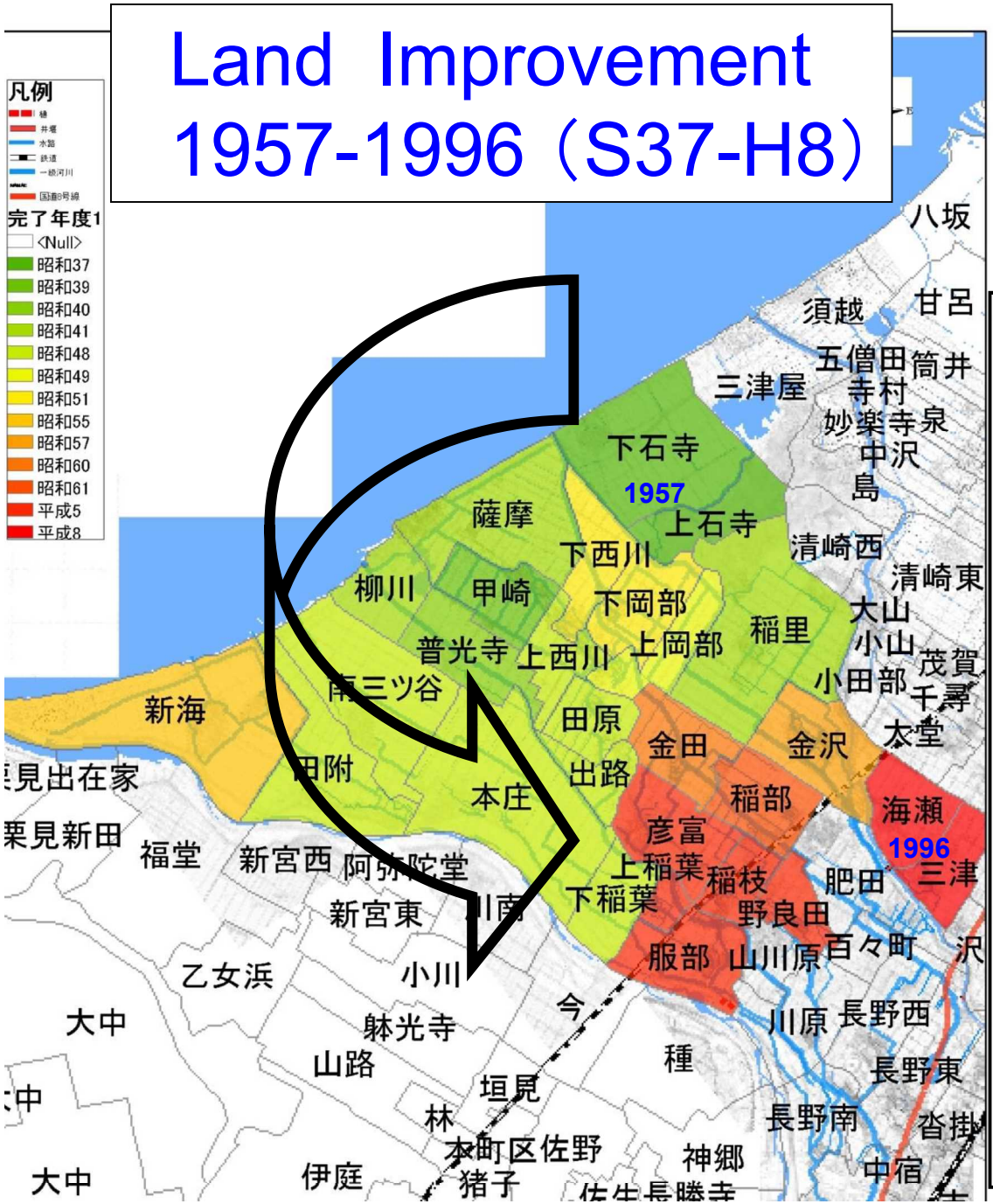
Cognitive conflict between stakeholders

Proximate cause: irrigation system change

But…the problem still exists



Land Improvement 1957-1996（S37-H8）



Changes in *Japan Agricultural Policy* and *Inae District*

Phase 1: Postwar recovery(1945~),
Creek agriculture/ Flood-prone areas

↓

Phase 2: Agricultural infrastructure (1950's~
Land Improvement program（1957~）

↓

Phase 3: Rice acreage reduction（1970~）
Farm mechanization/Side jobs
Abandonment of agriculture/Urbanization
Lake Biwa Comprehensive Development
（1972~）

↓

Phase 4: Food control abolishment (1994)
Difficulty in finding successors
Multifunction of agriculture
Collaboration: community & agriculture
Lake Biwa Comprehensive Development
（~1997）

Transformation after Land Improvement（1957-1996）

3 Nov. 1947

U.S. forces:
255VV 3IPRS M624 3/4ew 3 NOV 47 27

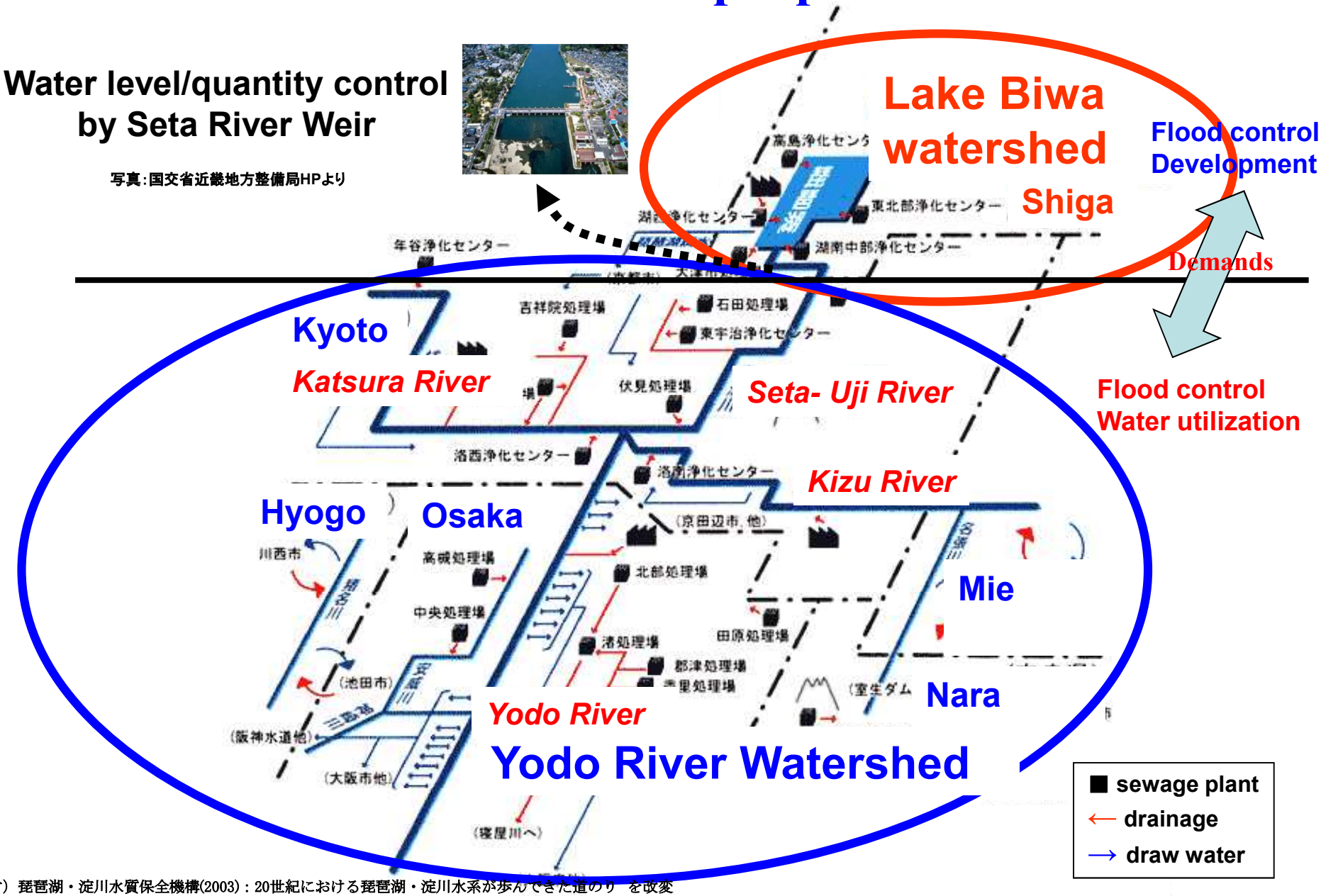
24 Sept. 2001

Geographical Survey Institute:
KK-2001-1Y C8-4

Transformation of Lake Biwa-Yodo River Watershed
-Lake Biwa as Multipurpose Dam-

Water level/quantity control by Seta River Weir

写真:国交省近畿地方整備局HPより



財）琵琶湖・淀川水質保全機構(2003)：20世紀における琵琶湖・淀川水系が歩んできた道のり　を改変

Farmers are worried more about their community future

Promotion of agricultural efficiency (1950-1970)
Land Improvement policy (1957~)

↓

Pipe-line Irrigation system (proximate cause)
Reduction of acreage under rice-cultivation (1970~)
Discouraging prospect for farming / Agriculture as side job

↓

***"Dilemma to maintain agriculture in adversity* (1990's~present)"**

Nested structure caused *conflicts of interests* among stakeholders!

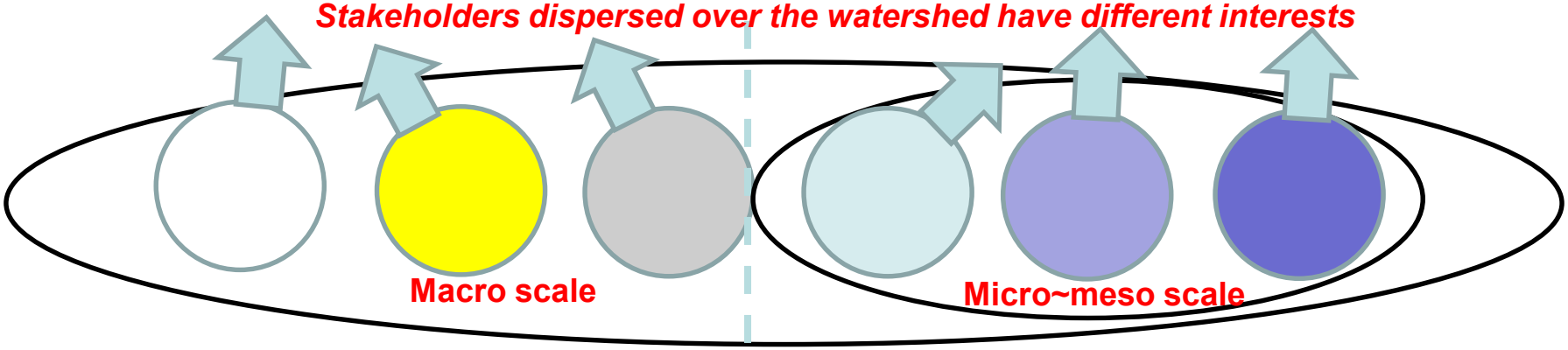
Macro scale

Ecosystem restoration

Micro~meso scale

Community revitalization

Stakeholders dispersed over the watershed have different interests



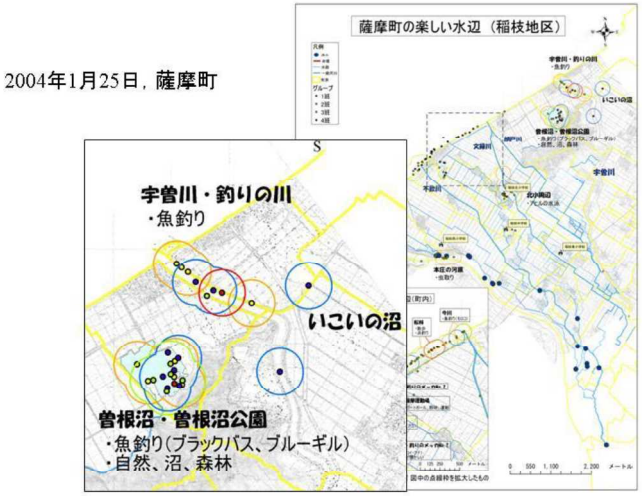
Communication Design for Watershed Governance

Communication Design for Watershed Governance

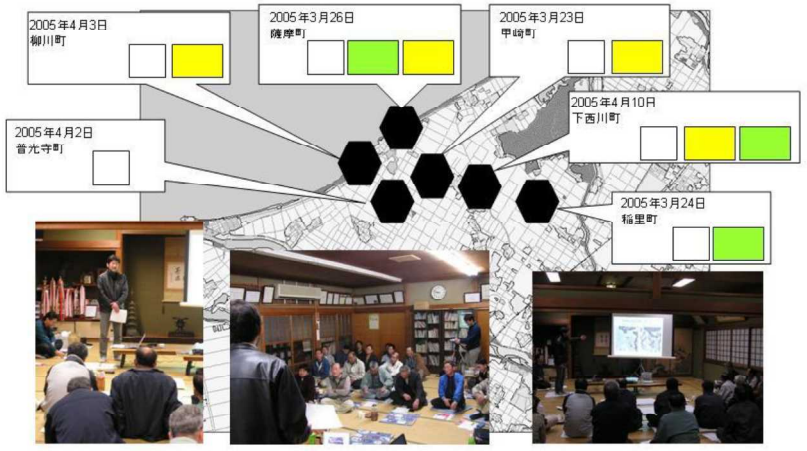
Interviews in local communities

Workshops in Three towns

Mapping residents' precious water shores



Seeking social-psychological factors



Mutual catalyzation of Ecosystem Restoration and Community Revitalization *through Communication*

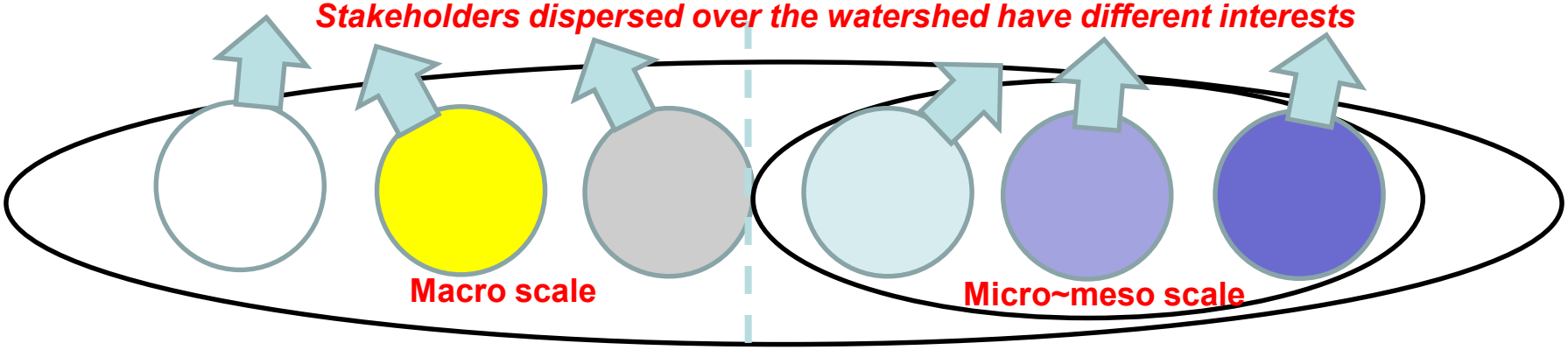
Macro scale

Ecosystem restoration
- Science-based knowledge
- Issue-oriented
- Top-down

Micro~meso scale

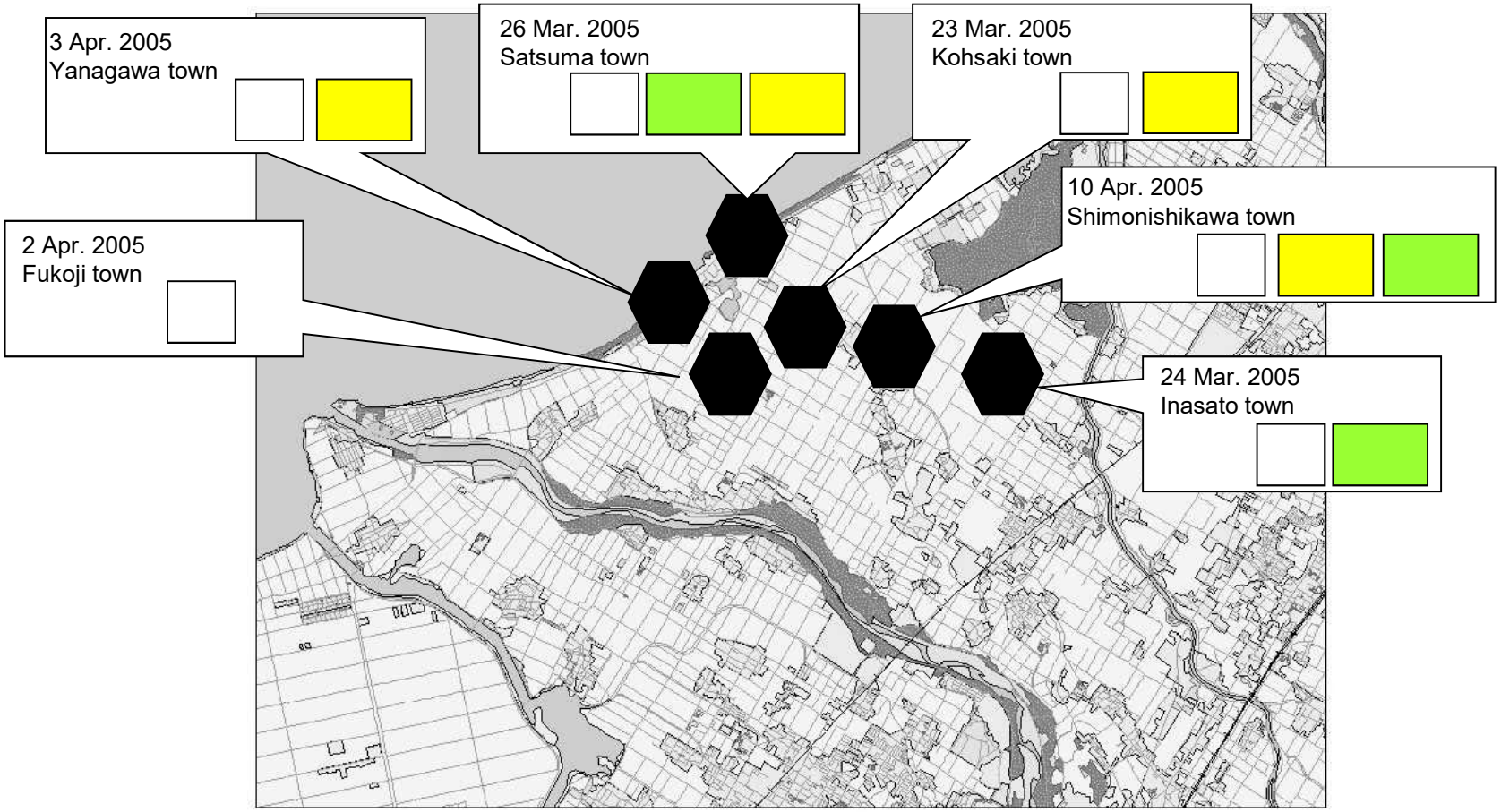
Community revitalization
- Residents knowledge
- Context-dependent
- Endogenous (bottom-up)

Stakeholders dispersed over the watershed have different interests



Workshops in 6 towns

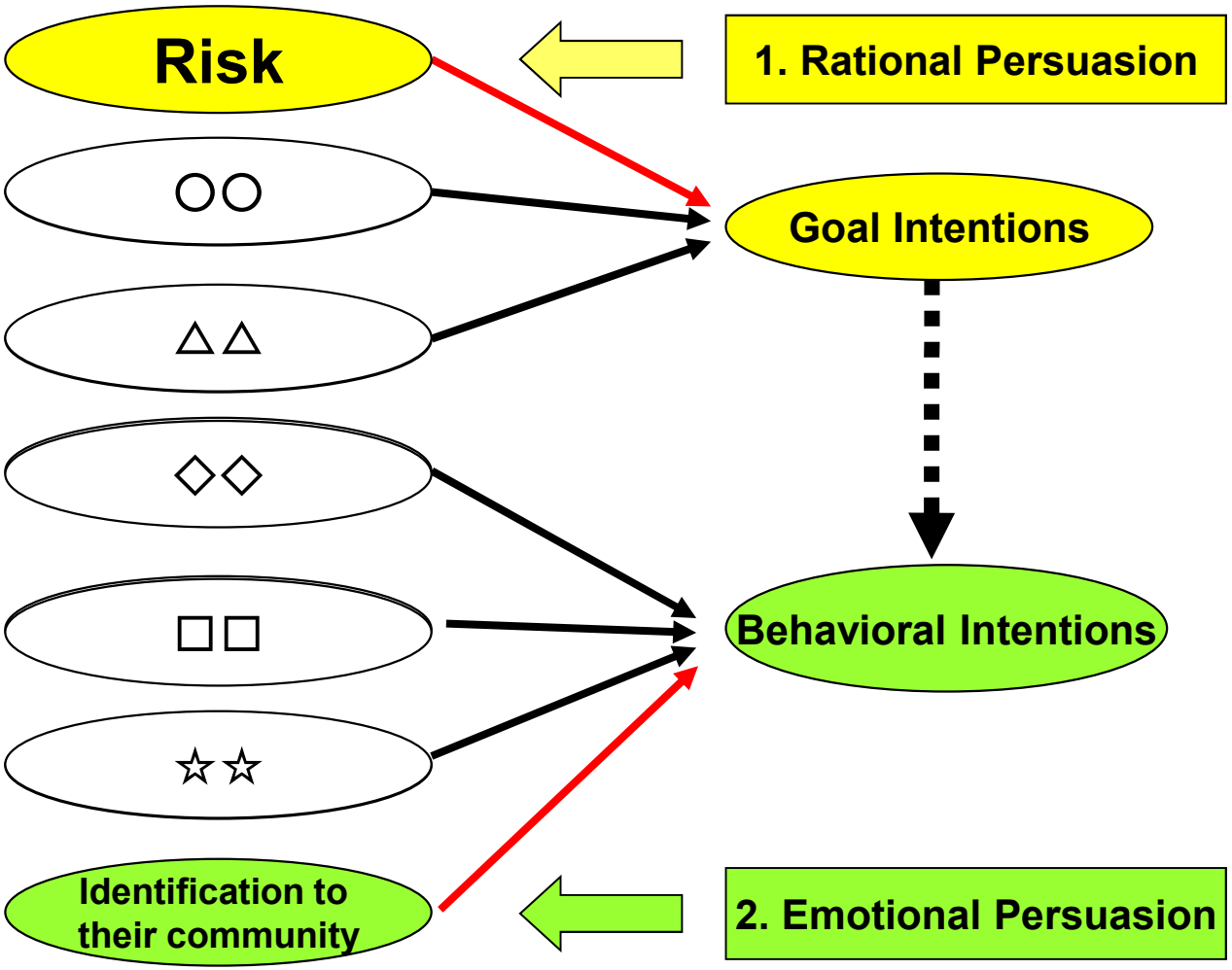
Social psychological Factors

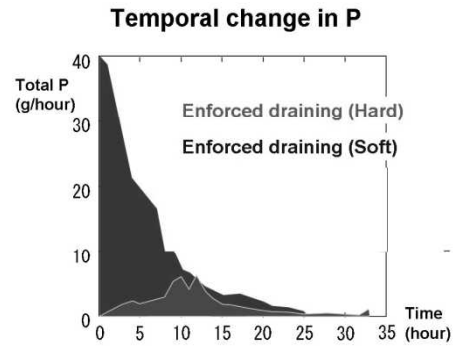


Report research results to farmers
-Seeking factors to bridge scales and interests of stakeholders-

Environmental Consciousness Behavior Model

(Hirose 1995, Nonami & Kato 2006)





Scientific information

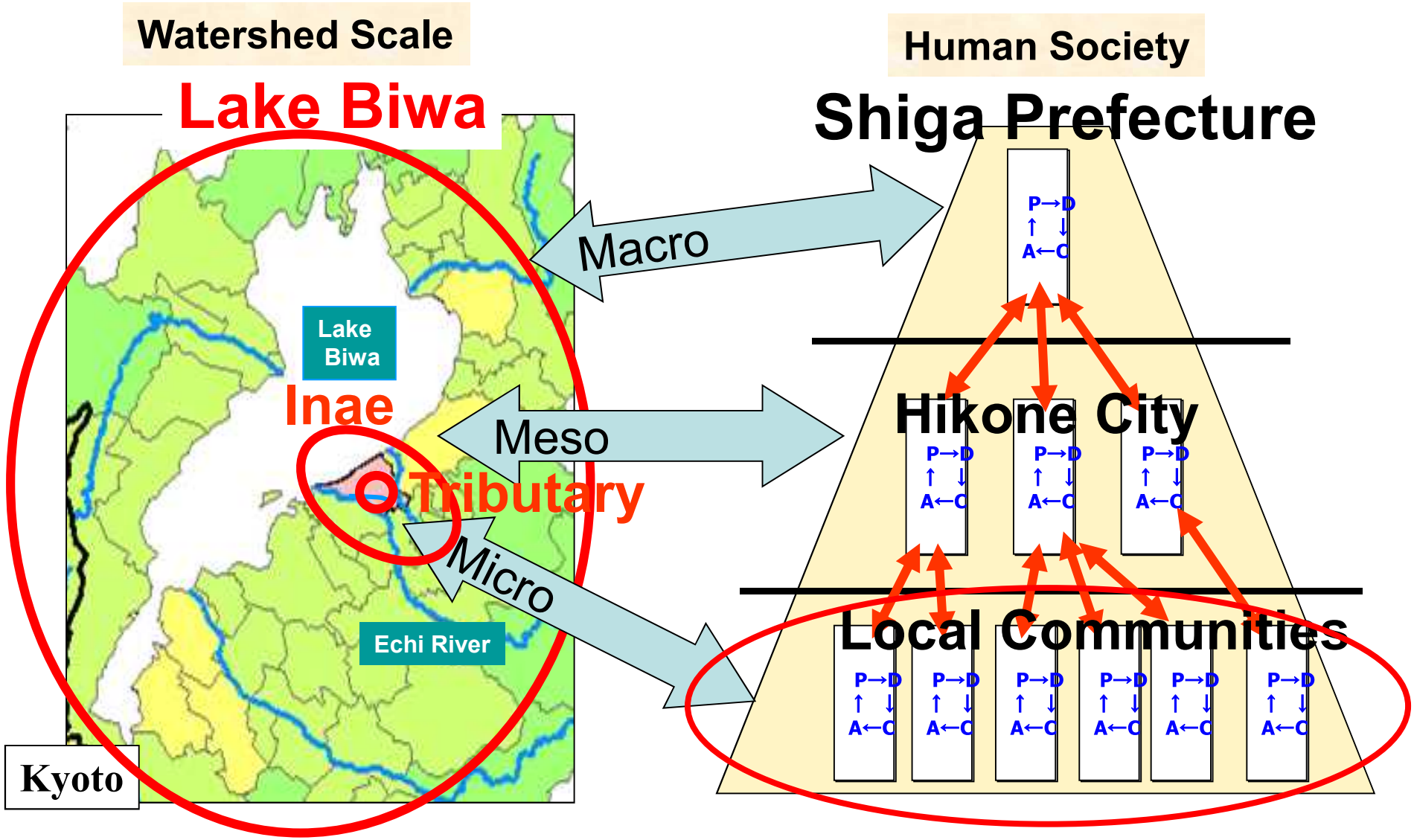
Information such as the farmer's attachment to their local areas and living things

Hierarchical Watershed Management

- ***Watershed*: *Spatial unit* of physical & ecological connection**

- ***Hierarchy*: *Barriers* which blocks stakeholders from mutual understanding**

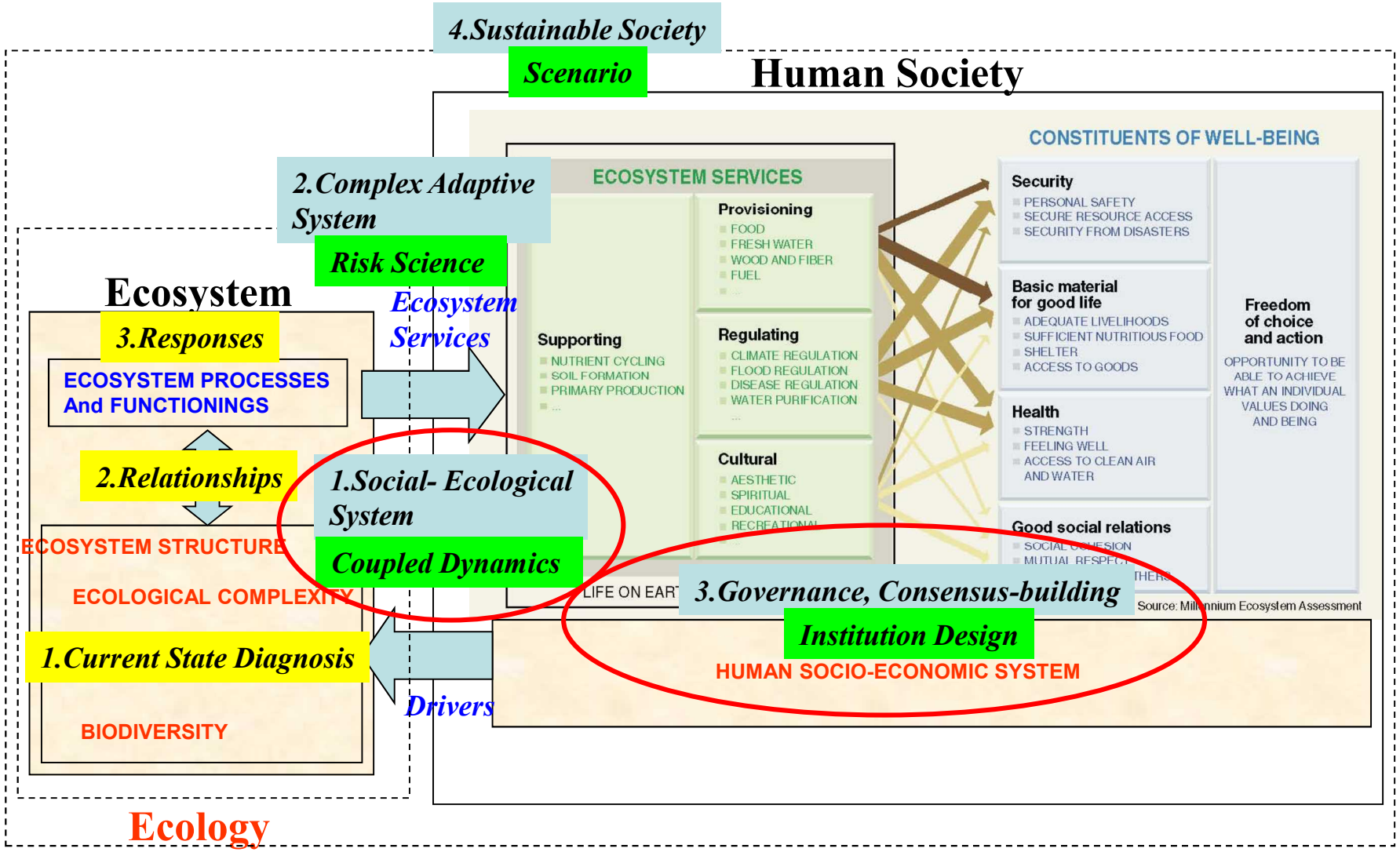
Communication design
to bridge the stakeholders
dispersed over the watershed!



Hierarchical Watershed Management

1. Adaptive management (PDCA cycle)
2. Communication between different spatial levels

Linking Ecology and Sustainability Science



Acknowledgements

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