Transdisciplinary science toward the adaptive watershed governance: Biodiversity-driven nutrient cycling and human well-being

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1. Research background and objectives
Technological innovations in the use of nutrients, such as nitrogen and phosphorus, to produce food contributed to the great global increase in population, life expectancy, and economic prosperity experienced in the twentieth century. Overexploitation of nutrient resources, however, causes disturbance of natural biogeochemical cycles, accounting for serious eutrophication in many watershed ecosystems around the world. Such nutrient imbalances are a main driver of biodiversity loss on a global scale, leading to deterioration of its ecosystem functions and services. It is now recognized that nutrient imbalances and biodiversity loss are prevalent throughout the planet, posing a risk to sustainable human development. In order to solve these problems related to nutrient imbalances and to ultimately ensure sustainable social-ecological systems, we have to enhance nutrient recycling on watershed scales.
Under such a background, we aim to facilitate cross-linkage of the multi-level governance, in which governments and researchers with a systemic view intend to solve nutrient imbalance-derived issues on the regional and global scales, while civilians want to solve social and environmental issues in the context of their life and livelihood. For such watershed governance to be successful, local and scientific knowledge must be shared and integrated by a variety of stakeholders to reconcile conflicts and interests emerging on different scales. Here I will develop a framework for the adaptive watershed governance, in which civilians are empowered for nature conservation, resulting in enhancement of their well-being, while scientists show how biodiversity enhances nutrient recycling through their conservation activities.
2. Hypothesis
Our hypothesis is that human activities affect biodiversity through alteration of nutrient balances, while biodiversity affects human well-being through alteration of social capitals. A working hypothesis is proposed to explain how the well-being is enhanced through the nature conservation (Fig. 1). First, local communities will be empowered for the nature conservation when they valuate biodiversity whose wise and sustainable use has been fostered by local knowledge for indigenous culture (Fig. 1-1). If bonding social capitals are accumulated through sharing of the indigenous cultural values among the community member (Fig. 1-2), the well-being will be enhanced (Fig. 1-3). If scientific knowledge showing that the community activities contribute to enhancement of biodiversity-driven nutrient recycling, which ensures public values for sustainability of social-ecological systems, is shared among a variety of stakeholders in the watershed society (Fig. 1-4), the community activities will be supported by non-community members directly or indirectly through social evaluation of public values produced from the biodiversity conservation (Fig. 1-5). A shift from bonding to bridging social capitals will also enhance the well-being (Fig. 1-6). These processes will be driven by transdisciplinary science (Fig. 1-7).
3. Methods
To test this hypothesis, my research project will practice the adaptive watershed governance in two extreme systems, the Lake Biwa Watershed and the Laguna de Bay Watershed, in Asia: the former is infrastructure-oriented low-loading society and the latter high-loading developing society. Finally, I want to find the fundamental framework of the adaptive watershed governance applicable to a variety of society.

4. Perspectives
In developed societies, establishment of infrastructure, such as sewage treatment and tap water systems, has reduced eutrophication, making human life more comfortable and convenient. However, environmental consciousness has been distant from the nature of wetlands as lifeworld. So, what enhances human well-being? Is it enhanced by the infrastructure? We want to seek answers to these questions.

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