Research Program 1

Societal Transformation under Environmental Change

This program aims at providing realistic perspectives and options to facilitate the transformation towards a society that can flexibly respond to environmental changes caused by human activities such as global warming and air pollution, as well as to natural disasters.

To demonstrate the fundamental significance of global environmental sustainability for human society, we need to make intellectually explicit the links between environmental change and natural disasters on the one hand, and social issues such as livelihood, inequality, social security and conflict on the other, and reinforce understanding of these links in the real world. RIHN's Societal Transformation under Environmental Change research program contributes to this task.

The Program follows two lines of inquiry. The first conducts research on Asia's long-term paths of social and economic development in relation to climate change and environmental history. Such studies offer historical understandings of the human-nature interface, and evaluate each region's political and economic conditions and cultural and social potentialities in comparative perspective. For example, postwar development of the industrial complex along Asia's Pacific coast was made possible by the combination of imported fossil fuels and utilization of rich local resources of land, water and biomass. Industrial development in the region produced both rapid economic growth and at times severe environmental pollution and degradation. It is important to recognize the causes and consequences of these historical processes in their own light, as well as for their significance to future societal change and policy deliberations.

The Program's second line of inquiry examines the kinds of motivations that affect people's livelihood, by working closely with various stakeholders in local society in Asia. Our project based in Sumatra's tropical peat swamp forest, for example, has identified four principal kinds of motivations—local livelihood; profit of local farmers and agricultural and industrial enterprises; local and centrally-based governance; and conservation measures implemented by governments, NGOs and international institutions—and examines how they can best be coordinated to promote sustainability at the village level. Research also helps implement policies at local, national and international levels. This ongoing project, which cooperates with local universities, companies and officials, has already contributed to the development of regional and national policies to control peatland fires, which became a significant environmental issue in Indonesia and beyond.

This program coordinates a variety of research projects along these lines in order to develop a perspective that helps direct research and social transformation in Asia.

Recent land development activities in some parts of tropical peatlands have led to unpreceded scales of forest fire incidents, which are a serious health threat to people of local areas and neighboring countries. This photograph shows a peatland fire in Riau Province, Sumatra Island, Indonesia.

Program seminar at RIHN, 29th January 2018

Program Director **SUGIHARA Kaoru** RIHN

Trained in Japan (Doctorate at the University of Tokyo), I have held positions at the History Department of the School of Oriental and African Studies, University of London, the Center for Southeast Asian Studies, Kyoto University, the Graduate School of Economics, University of Tokyo, and the National Graduate Institute for Policy Studies (Japan). My research concerns the history of intra-Asian trade and labor-intensive industrialization in the last two centuries. I am currently working on the economic and environmental history of Monsoon Asia in long-term perspective. I also act as Vice-Chair of the Future Earth Committee of the Science Council of Japan

Researchers

MASUHARA Naoki	Senior Researcher
YAMAMOTO Aya	Research Associate

HISTORICAL CLIMATE ADAPTATION PROJECT

Societal Adaptation to Climate Change: Integrating Palaeoclimatological Data with Historical and Archaeological Evidences

Project Leader **NAKATSUKA Takeshi** RIHN

Professor Nakatsuka's specialties are palaeoclimatology and isotope biogeochemistry. Since his early career as a graduate student, he has been using nitrogen isotopes to study long-term variations of climate and its impacts on oceanic biogeochemical cycles. Recently, he changed his main research area from oceans to land and focused on using tree-ring oxygen isotopes to examine the relationship between climate change and human history. Investigating periodicity of climate during the last three millennia in Japan and the world, he now hypothesizes that past human societies were often damaged by multi-decadal climate variations as they were caught in a cycle of over-adaptation and subsequent failure of adaptation.

Program 1

Background and objectives

If global warming causes many societal difficulties, how can we adapt to the change? Remarkable recent progress in palaeoclimatology has elucidated the fact that large climate variations often underlay epochs of human history. How did our ancestors address such change in the past? Human history must include many examples from which we can extract common lessons relevant to contemporary global environmental change. The research target of this project is Japanese history from the prehistorical Jomon era to the present. First, we reconstruct past climate variations in Japan and Asia at annual time resolutions for the last several millennia, using up-to-date palaeoclimatological methods to identify outstanding periods of climate variation. Then we use historical and archaeological approaches to investigate how local societies reacted to climate variation in order to clarify common sociocultural characteristics of societies that are tolerant or vulnerable to changes in climate.

Research methods

In this project, past climate variations are reconstructed based on various proxies, such as tree rings (Photo 1), historical weather records, lake and marine sediments, coral rings and speleothem, and compared with human responses recorded in historical documents (Photo 2) and archaeological archives. There are three reasons why we have chosen Japan as the main research area in this project. First, Japan is located at northeastern rim of the Asian summer monsoon, where small changes in monsoon dynamics might have significantly affected rice paddy cultivation on which Japanese sustenance has historically depended. Second, due to the historically high literacy rate and long-lasting family system in Japan, innumerable historical documents dating back to the 8th century are preserved in both private and governmental sectors. Third, rapid land developments during last several decades have allowed for precise archaeological excavations at numerous sites all over Japan. In addition, a palaeoclimatological tool (tree-ring cellulose oxygen isotope ratio) particularly useful in the Asian monsoon region has recently been developed to reconstruct summer precipitation on which rice paddy cultivation in Japan depends, providing archaeologists with a reliable tool for annual dating of numerous excavated woods (Photo 3).

Remarkable results

We have used many tree-ring samples from around Japan in order to analyze tree-ring oxygen isotope ratios during the last 4800 years in annual time resolution. We have also collected many tree-ring width datasets from all over Asia in the framework of an international palaeo-climatological project (PAGES) and reconstructed inter-annual variations of averaged East Asia summer temperatures. Comparison of annual climate records and paleographic information such as yearly tax accounts in early modern villages and administrative documents on water control in medieval manors, archaeological evidence on prehistorical and ancient societies excavated from farmland and habitat remains, and the newest isotopic dendrochronological data (Fig. 1) allows us to investigate how variations in temperature or precipitation influenced agricultural production, human livelihoods, and water management. As a result, we can understand how historical societies could or could not overcome serious climate changes in the past. For example, in the Medieval period, sudden

Photo 1 Sampling of a tree ring core from a living tree using an increment borer

Photo 2 Collection of historical information by investigation of old documents

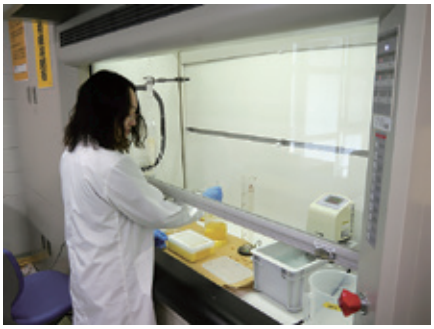

Photo 3 Extraction of tree ring cellulose from archaeologically excavated wood

http://www.chikyu.ac.jp/rihn_e/project/H-05.html
http://www.chikyu.ac.jp/nenrin/index_e.html

decreases in summer temperature often caused serious famines in Japan, though there were important exceptions during late 13th and 14th centuries (Fig. 2). On the other hand, sudden increases in precipitation often caused water disasters and subsequent social conflicts, analysis partly infered from the number of old documents relevant to emergence of "Akuto" (outlaws) in the Kamakura era (Fig. 3). Such relationships between precipitation, disaster and societal change can be traced back to the early period of the Yayoi era about 2500 years ago.

Final goal

As our present concerns for global warming clearly illustrate, large climate variations in the past have had serious impacts on our ancestors. As shown in Figs. 2 and 3, significant multi-decadal climate variations had especially negative impacts on historical societies. However, some past societies continued to attempt to overcome the influence of climate variations, while other societies collapsed. Comparative evaluation of historical climate adaptations may allow us to explain Japanese history since the Jomon era as a sequence of societal transformations designed to overcome large-scale intermittent climate variation. The final goal of this project is to bring such historical analysis to bear on fundamental adaptation strategies considered in relation to contemporary global environmental problems.

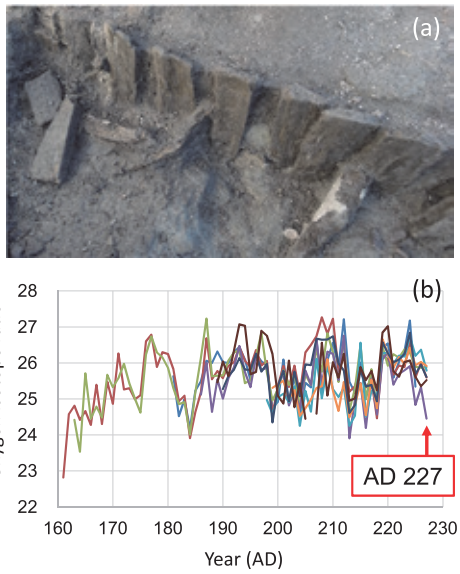

Figure 1 **Numerous wooden posts along an ancient waterway excavated from Shoji remain in Neyagawa city, Osaka prefecture (a) and variations in their tree-ring cellulose oxygen isotope ratios (b). Coincidence of the variations among many posts indicates that this waterway was constructed in 227AD. Samples of wooden posts were provided by Neyagawa city board of education.**

Figure 2 **Variations in East Asia summer temperature (red: reconstructed from tree ring width database in Asian wide region) and famine reports in Japan (green: number of old documents from each year containing famine-words) during Medieval period.**

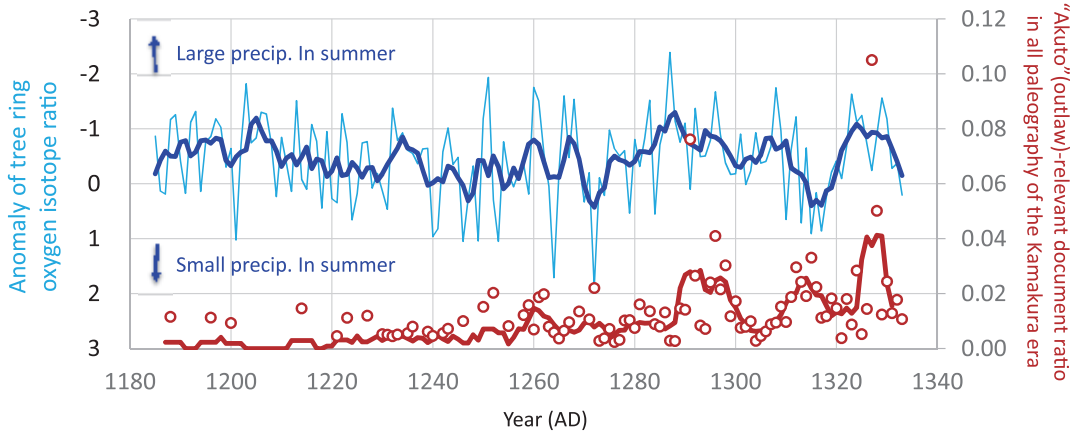

Figure 3 **Variations in Central Japan summer precipitation (blue: inferable from tree-ring oxygen isotope ratio) and documents related to "Akuto" (outlaws) (red: yearly ratios in all paleography) during the Kamakura era, 1185-1333 AD. Thick lines indicate five-year averages.**

Sub Leader

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Toward the Regeneration of Tropical Peatland Societies:
Building an International Research Network on Paludiculture and Sustainable Peatland Management

Project Leader **MIZUNO Kosuke** RIHN/Kyoto University

Kosuke Mizuno has been studying the Indonesian economy since 1978, focusing primarily on how economic change unfolds in rural West Java. Mizuno places special attention on issues of land, capital, and labor relations. Following the Indonesian democratization process and particularly the restoration of the right to organize in 1998, when former President Suharto stepped down, Mizuno has analyzed institutional change, economic development, and resource management within people's organizations such as farmers' unions and trade unions. He became the leader of an integrated natural and social science study on peatland society in Riau province in 2008, and continues to conduct action research on peatland rehabilitation. Mizuno strives for a deeper understanding of the historical and social dimensions of peatland society, and considers the commodities found therein, such as palm oil, to be crucial for the analysis of the Indonesian economy as a whole.

Necessity of the study

Peat swamp forests are found throughout Southeast Asia, especially Indonesia, and contain massive stores of carbon and water. Over the last two decades, these swamps have been intensively exploited in order to create commercial acacia and oil palm plantations. As these tree species cannot grow in swamps, peatlands have been drained, creating extensive areas of dried peatlands that are extremely vulnerable to fire.

In 2015, peatland fires burned 2.1 million hectares of forest in Indonesia, affecting 45 million people. A half million people suffered from upper respiratory tract infections, and thousands of people, especially children, were afflicted with asthma. The government responded to this disaster by mobilizing the army, punishing people who set fires, and refusing to issue new peatland development permits. These measures were urgently needed, but provided only short-term relief. The public has demanded longer-term and more sustainable measures, such as the rewetting and reforestation promoted by this project since 2012.

The government of Indonesia established the Peatland Restoration Agency in January 2016, and declared that two million hectares of degraded peatlands will be restored by 2019. The objective of this research project is to generate solutions to the current crisis of peat degradation and related fire and haze in tropical regions through action research. The project seeks to identify and implement alternative practices in collaboration with local people, academics, governmental offices and officials, NGOs, and international organizations.

The project conducts multidisciplinary research in order to clarify the entire process of peatland degradation. We focus on: A) gathering social and ecological baseline data on peatlands and measuring the impacts of fire and haze; B) implementing paludiculture projects in wetland areas as a potential strategy for the mitigation of peatland degradation; and C) identifying governance structures and incentives, including strengthening the land rights of people situated on state land, which can support sustainable peatland management. These studies are conducted in collaboration with local people, migrants, NGOs, plantation companies, and local and national governments.

Photo 1 Rewetting by small wooden dam in Kepau Baru village, Meranti, Riau

Achievements to date

Project researchers introduced the practice of rewetting and reforestation in peatland areas in Bengkalis District, Riau Province in 2010. This experimental site has attracted significant attention, especially since 2015 when fire and haze became very serious. Along with project-led international seminars, the site has significantly enhanced public awareness of the potential for rewetting and forestation to regenerate peatland.

On August 10, 2016, the Research Institute of Humanity and Nature, Kyoto University, and Hokkaido University

Photo 2 Sago paludiculture in Kepau Baru village, Meranti, Riau

signed a Memorandum of Understanding with the Peatland Restoration Agency of Indonesia to conduct action research to restore degraded peatland. Our project has created action plans based on this MOU and has accordingly begun to implement a restoration program in Meranti District, Riau Province. We started to discuss the social forestry programs that are designed to strengthen the land rights of people on the degraded state land among local people, the Ministry of Environment and Forestry, local governments and NGOs.

Research Targets

Peatland ecosystems are vulnerable. Damage from human disturbance can be irreversible. In order to achieve long-lasting solutions to peatland degradation, we investigate the social and ecological aspects of peatland vulnerability, and propose many programs to transform these vulnerabilities. Our research objective is to examine alternative livelihood strategies while building/changing the institutions that can encourage people to restore and make sustainable use of degraded peatlands. The project supports community-initiated paludiculture as a sustainable livelihood model in rewetted peatlands while strengthening land rights on state land though social forestry programs. This research thus demonstrates the future potential of peatland-based societies, the phasing out of monoculture production activity, the development of paludiculture, and the enlargement of protected peatland areas.

Publications

Catastrophe and Regeneration in Indonesia's Peatlands: Ecology, Economy and Society was published by the National University of Singapore Press in 2016. This volume provides inter-disciplinary field-based and historical analyses of peatland degradation through examination of the survival motives of local people, the profit motives of companies, and the conservation motives of Government and NGOs. The book showcases the potential solution of rewetting and reforesting "the people's forest". The book has been reviewed across various forms of media, including leading international academic journals. Our project will continue to build on this research in order to develop new insights on tropical peatland management.

Photo 3 Seedling for reforestation in Kepau Baru village, Meranti, Riau

Sub Leader

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Research and Social Implementation of Ecosystem-based Disaster Risk Reduction as Climate Change Adaptation in Shrinking Societies

Project Leader **YOSHIDA Takehito** RIHN/The University of Tokyo

Takehito Yoshida is an ecologist and limnologist who studies diversity and complexity of organisms and ecosystems from the viewpoints of adaptation and system dynamics, and explores human-nature interactions and sustainability in local communities in Japan. Trained in Kyoto University (PhD) and Cornell University (postdoc), he was a member of the faculty at the University of Tokyo at Komaba before jointly appointed at RIHN and the University of Tokyo.

Outline of the project

The rate of natural disaster occurence has been increasing, partly due to contemporary climate change, and adaptation to natural disaster risks is increasingly important to the sustainability of human societies. At the same time, many societies are experiencing shrinking populations. Ecosystem-based Disaster Risk Reduction (Eco-DRR) takes advantage of the multi-functionality of ecosystems and biodiversity, including their capacity to mitigate natural disasters while providing multiple ecosystem services, and population decline provides ample opportunity for implementing Eco-DRR. Our project will develop practical solutions for implementation of Eco-DRR by visualizing natural disaster risks, evaluating multi-functionality of Eco-DRR solutions, conducting transdisciplinary scenario analysis, examining traditional and local knowledge of disaster risk reduction, and collaborating with the insurance industry and other sectors.

Background and goals

Climate change impacts natural and human systems and is projected to intensify in the future. Our project focuses on natural disasters, and it aims to contribute to risk reduction and management strategies. Climate change or natural disaster risks result from the interaction between a climate-related hazard, and the exposure and vulnerability of human activities (Fig. 1), so that adaptation to natural disaster risk can be realized by reducing exposure (e.g. by improving land use) and vulnerability to hazards.

Hard-engineering natural disaster countermeasures have target safety levels, below which natural disasters can be prevented. Although these countermeasures are effective if the hazard level of natural disaster is below the target safety level, we are increasingly faced with situations in which hazard levels exceed safety levels, resulting in devastating natural disasters. Eco-DRR approaches focus on lowering the exposure of human activities to natural hazards, so reducing, if not preventing, associated losses and damages. Eco-DRR approaches, meanwhile, take advantage of the multi-functionality of ecosystems, so complementing conventional approaches to natural disaster management, although the effectiveness and multi-functionality of Eco-DRR is not yet clearly and quantitatively understood.

Japan's population is aging and shrinking, leading to the abandonment of farmlands, houses and decreases in other intensive land uses, a challenging circumstance that nevertheless provides an opportunity for improving land use. The population of Japan increased substantially over the last century, increasing the risk of and public exposure to natural disasters. Evaluating past natural disaster risks therefore provides valuable information of adaptation

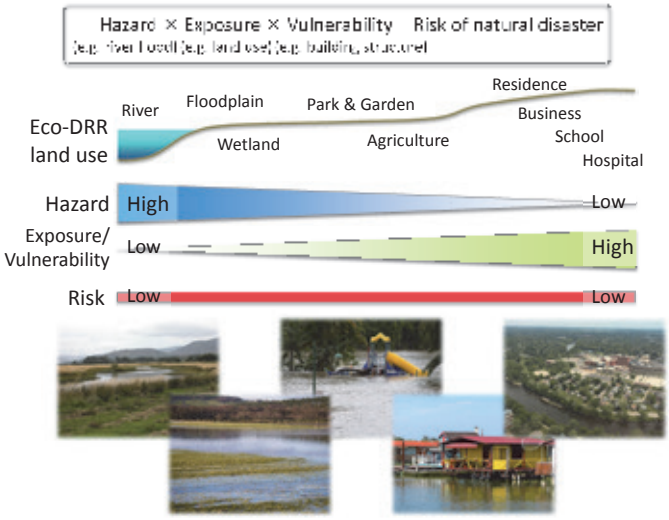

Figure 1 Ecosystem-based disaster risk reduction not only lowers disaster risks but also receives benefits of ecosystem services by reducing the exposure of human activities in high-hazard locations and supporting human activities in low-hazard places.

strategies considered in Japan as well as in other countries.

Given this background, the ECO-DRR Project sets two main goals: first, it develops methodologies to evaluate Eco-DRR multi-functionality and assess Eco-DRR by comparing multi-functionality between the past, the present and the future. Secondly, the Project supports Eco-DRR implementation through transdisciplinary collaborations with local communities, governments, insurance industry and other stakeholders.

Research objectives

Three research components contribute to achieve the above two goals.

(1) Visualizing the risks of natural disasters in the present and the past

The exposure and vulnerability associated with different natural disasters will be analyzed, and the risks evaluated and visualized as risk maps of the present and past. Modeling risk for the different exposure scenarios will contribute to future Eco-DRR assessments and plans.

(2) Evaluating and modeling multi-functionality of Eco-DRR

Provisioning, regulating and cultural ecosystem services will be evaluated, and their spatial distribution will be modeled in relation to population and land use. The model will be used for evaluating the ecosystem services for different land use scenarios.

(3) Transdisciplinary scenario analysis and developing social and economic incentives of Eco-DRR

Together with local communities and governments, transdisciplinary platforms will be formed at research sites to deepen understanding, discuss future options, and build consensus around Eco-DRR approaches. Transdisciplinary scenario analysis will be conducted in consideration of climate change and shrinking population. In addition, traditional and local knowledge of disaster risk reduction will be inventoried and evaluated for multi-functionalities shared in the platform.

In collaboration with the insurance industry, a research forum will be formed to discuss the possibility and feasibility of insurance industry-led contributions to and economic incentives for Eco-DRR. The research forum will also assess various laws and institutions in national and local governments related to disaster risk reduction and land use.

Photo 1 **Mikatagoko area in Fukui Prefecture, one of the research sites.**

Photo 2 **Hira mountains and their base area in Shiga Prefecture, one of the research sites. Photo courtesy of MATSUI Kimiaki.**

Researchers at RIHN

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Research Program 2

Fair Use and Management of Diverse Resources

Global environmental problems are inter-related. Studies concentrating on single issues are often not effective; consideration of inter-linkages of multiple resources involving stakeholders are essential. Recently, the nexus structure linking energy, water and food production has become a prominent area of study, but truly sustainable societies require more comprehensive understandings of the ecological resources that provide ecosystem services and cultural resources. The production, circulation and consumption of resources should be discussed in a wide range of spatial scales, and stakeholders should be involved in these discussions. Sustainable use of resources requires fair and wise systems and proper indices to manage these processes.

In particular, it is necessary to transform existing socio-economic or human behavioral systems to new systems that pay greater attention to renewable natural resources, as these have sometimes been externalized from conventional economics. Asia is experiencing rapid change in economy, urbanization and population, though traditional techniques for sustainable resource management, associated with the relatively rich humanospere and cultural background in this region, also survive. Studies of such experience of resource use in Asia may thus give important suggestions to sustainability in general.

RIHN research projects have accumulated information and suggestions necessary for this transformation, though gaps remain. Program Two therefore explores wise and fair management systems capable of addressing multiple resource-uses by multiple stakeholders, in multi-spatial scales. We encourage new project proposals including those by innovative young scientists addressing such novel and under-examined subjects. Internal Program discussion will address the conditions necessary for transforming values and human behavior, as we propose new indices and institutions for fair resource management.

In fiscal 2017, we conducted a research review on the issue of equity in relation to the concept of fair use. We considered several dimensions of equity, including (1) economic equity related to the burdens and benefits of resource use, and procedural equity focusing on procedures for making such decisions; (2) the question of equity between whom, for instance, between modern generations, modern generation and future generations and human society and natural society; and (3) the question of who will or should evaluate equity is also an important element. In addition, in our first year of activity we also established a framework for understanding fair use.

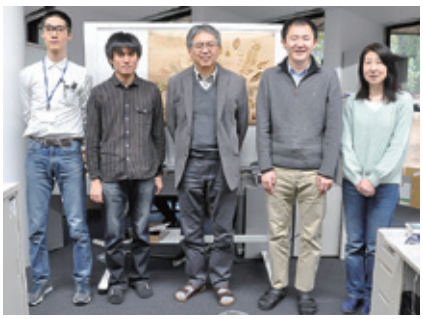
Agricultural land in India

Logging of tropical rain forest in Malaysia

Palm oil factory in Malaysia

Program Director **NAKASHIZUKA Tohru** RIHN

Tohru Nakashizuka has studied forest ecology, biodiversity and ecosystem services at the Forestry and Forest Products Research Institute, Kyoto University as well as at Tohoku University. At RIHN, he is to study wise and fair use of diverse resources.



Researchers

KOBAYASHI Kunihiko	Researcher
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KARATSU Fukiko	Research Associate

Biodiversity-driven Nutrient Cycling and Human Well-being in Social-Ecological Systems

Project Leader **OKUDA Noboru** RIHN

My specialty is ecology, the field of study concerned with the relationships between biodiversity and ecosystem functioning. One of ecology's central questions is why humankind should conserve biodiversity. As a member of the Center for Ecological Research at Kyoto University, I have approached this question by integrating different research fields related to biodiversity from gene to ecosystem. At present, I am developing methods for adaptive watershed governance that allow new environmental knowledge to reconcile global, regional, and local ecological issues. I should also say that I love nature and humanity and how they come together very much!

Research background and objectives

Technological innovations in the use of nutrients for food production, in particular nitrogen and phosphorus, have allowed global increases in population and economic prosperity in the twentieth century. Overexploitation of nutrient resources, however, affects biogeochemical cycles and can lead to nutrient imbalances, eutrophication and loss of biodiversity. It is now recognized that nutrient imbalances and biodiversity loss are prevalent in watersheds around the world, and pose a risk to sustainable human development.

In spite of such risk, most citizens are not so interested in global environmental issues but are rather concerned about local issues related to their lives and livelihoods. Considering this dissonance in environmental consciousness, we aim to develop a framework for adaptive watershed governance to enhance social-ecological health of watershed system (Fig. 1).

Research methods

We facilitate stakeholder engagement in community activities in order to enhance biodiversity, nutrient cycling and human well-being, according to our hypothesis that these are three components essential to the social-ecological health of watershed system and, like gears, also interdependently linked into community activities (Fig. 2). We begin with action research to empower members of each community within a watershed to conserve indigenous environmental icons, defined as indigenous nature with special significance to local life and livelihood (Process 1 in Fig. 2). As the value of engaging in such conservation efforts is shared among community members, community-based well-being is altered and reinforced through bonding social capitals in a positive feedback of biodiversity conservation and biodiversity-driven nutrient cycling.

If such community activities enhance nutrient recycling at the watershed scale, they may benefit a variety of stakeholders other than the community members in ways not easily registered by local cultural values but inspired by the social-ecological health of watershed system . In disseminating our scientific understanding of the community dimensions of nutrient recycling, our project will facilitate social involvement in conservation activities as well as green consumption of local products by non-community members who appreciate social-ecological health. Such links accumulate bridging social capital and increase economic incentives (Process 2 in Fig. 2). With this scientific knowledge, community members may also gain institutional support from local governments. Such integration of local and scientific knowledge further enhances community-based well-being, and leads to empowerment of community activities.

Photos 1 Social engagement in biodiversity monitoring in the mid-stream community of the Yasu River sub-watershed

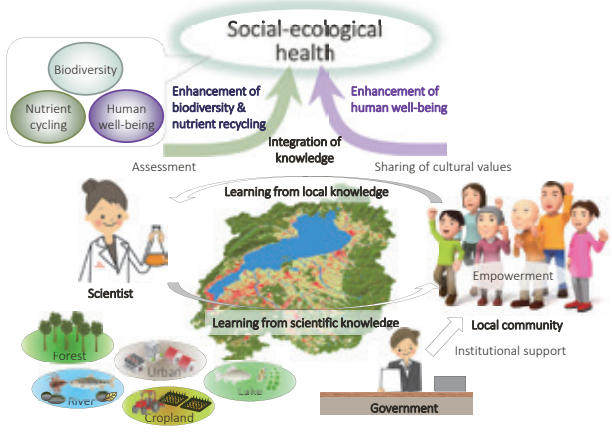

Figure 1 A conceptual schema of adaptive watershed governance

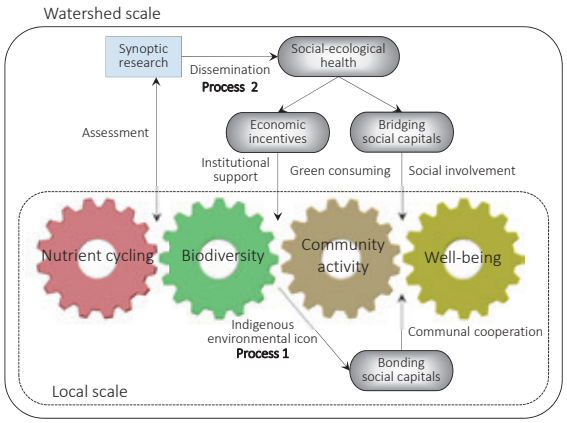

Figure 2 A working hypothesis of how biodiversity, nutrient cycling and human well-being are enhanced through the adaptive watershed governance

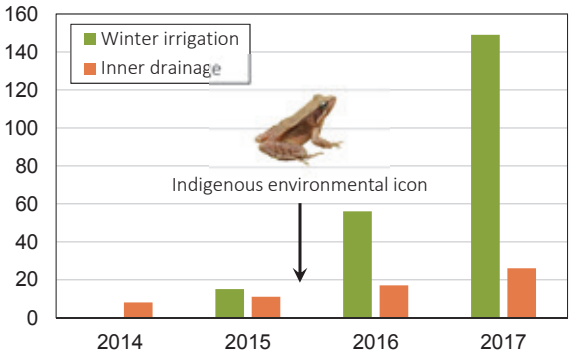

Figure 3 **Annual changes in the number of rice paddies in which eco-friendly farming was practiced. The community members regarded a brown frog as an indigenous environmental icon in 2016**

To investigate this positive feedback process, we compare consequences of our watershed governance activities in two extreme watersheds in Asia: the Lake Biwa Watershed (Japan) and the Laguna de Bay Watershed (Philippines). The former is an infrastructure-oriented society and the latter a high-nutrient loading society.

Research progress

We practiced action research in the mid-stream community of the Yasu River sub-watershed of Lake Biwa. Based on exercises to explore the cultural significance of indigenous nature, farmers identified a brown frog as an indigenous environmental icon and practiced eco-friendly farming to conserve its habitat. Monitoring revealed that the brown frog prefers to spawn in rice paddies with winter irrigation. Sharing of cultural values among the community members improved local engagement in conservation activities (Photos 1 & Fig. 3). We also found that eco-friendly farming had positive effects on wetland biodiversity, suggesting that the brown frog can serve as an indicator of local biodiversity as well as of the community-based well-being.

In the Laguna de Bay Watershed, in contrast, recent economic development has led to expansion of residential areas into the mid-stream area of the Silan-Santa Rosa sub-watershed. In downstream urban areas, nutrient loadings and eutrophication have led to significant loss of biodiversity. At present, people within the watershed are dependent on groundwater resources for drinking and irrigation and they are therefore highly concerned about groundwater overexploitation and pollution. Following our assessment of groundwater pollution, a watershed forum will be organized as a platform to discuss sustainable and fair use of groundwater resources. We will also conduct the action research to empower the mid-stream community to conserve a communal spring as an indigenous environmental icon (Photos 2).

Perspectives

In developed societies, sewage treatment and tap water infrastructure systems have reduced eutrophication and improved comfort and convenience. Environmental consciousness, however, has receded from the nature of wetlands. What enhances our well-being? Is it enhanced by infrastructure? Our research seeks answers to these questions together with a variety of stakeholders.

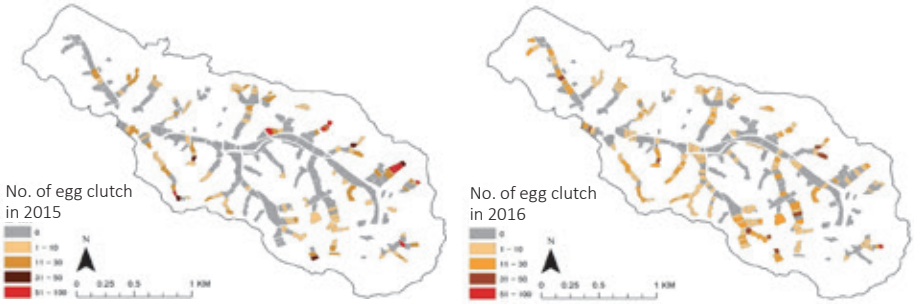

Figure 4 **The number of rice paddies spawned by brown frog increased with the prevalence of eco-friendly farming**

Photos 2 **In the mid-stream community of Silan-Santa Rosa sub-watershed, a communal spring serves as a drinking fountain (a), a chapel (b), a bath (c). Its admission fee is used for a community feast (d). A workshop on the sustainable use of communal spring (e-f)**

Sub Leader

YACHI Shigeo	Kyoto University

Researchers at RIHN

IKEYA Tohru	Researcher	**LAMBINO, Ria Adoracion Apostol**	Researcher
ISHIBASHI Hiroyuki	Researcher	**UEHARA Yoshitoshi**	Researcher
ISHIDA Takuya	Researcher	**WATANABE Kirie**	Research Associate

Main Members

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OSONO Takashi	Doshisha University	**SANTOS-BORJA, Adelina C.**	Laguna Lake Development Authority, Philippines
TAYASU Ichiro	RIHN		

Research Program 3

Designing Lifeworlds of Sustainability and Wellbeing

More than 60% of the world's population resides in Asia and over a third of global economic activity occurs there. Asia is comprised of an incredible diversity of cultures, histories, societies, economies, livelihoods, and ecologies. Asia is also affected by myriad global and local environmental issues, such as population increase, air, water, soil, and coastal pollution, increasing greenhouse gas emissions, and biodiversity loss. The region is also affected by growing wealth disparity, social isolation, rising levels of poverty, and the disappearance of traditional cultures and knowledge. The combination of migration between the countryside and cities, rural depopulation, and urban concentration is accompanied by rapid socio-cultural change, over-exploitation of resources, and deterioration of natural environments. Both urban and rural lifeworlds are disintegrating rapidly.

As a consequence, in reconstructing the lifeworld concept and highlighting the reciprocal linkages between rural and urban spaces, Program 3 designs lifeworlds of sustainability and wellbeing and co-creates concrete pathways for their realization. Program research is based on the diverse world-views and accumulation of experience of human-nature co-existence. These latent socio-cultural elements, such as livelihood styles, lay knowledge, conflict resolution strategies, and the vitality of the people themselves can be called upon to address contemporary problems and to help chart a course toward possible future societies. Program 3 builds upon these experiences and knowledges of human-nature interaction to propose concrete changes needed to achieve a sustainable society.

The transformations and frameworks leading to sustainable urban and rural lifeworld design, will also entail fundamental shifts in existing economic systems, markets, and political decision-making systems. Rather than investigating top-down approaches to system change, Program 3 will work with local residents, government officials, companies, citizen groups and other stakeholders to propose sustainable alternatives and gauge their feasibility.

In order to avoid the risk of developing proposals that are only applicable to specific regions or sites, Program 3 will aim for research results that are generalizable while also retain the diversity at the heart of local lifeworlds and wellbeing.

The varieties of fruits and vegetables for sale at the market in Kanchanaburi reflect Thailand's changing society

Socialization of composting type toilet in Burkina Faso, Photo by ITO Ryusei

Program Director **SAIJO Tatsuyoshi** RIHN

Tatsuyoshi Saijo (4th from left) specializes in designing social systems that promote sustainability and equity without inhibiting individual incentive. His interest is in developing the field of "Future Design", one that links the happiness and wellbeing of current generation to that of future generations.

Lifeworlds of Sustainable Food Consumption and Production: Agrifood Systems in Transition

Project Leader **Steven R. McGREEVY** RIHN

Steven R. McGreevy is an environmental sociologist (Kyoto University Ph.D. 2012) and associate professor at RIHN. He has a background in agriculture, rural sustainable development, and environmental education. His research focuses on novel approaches to rural revitalization that utilize local natural resources, sustainable knowledge dynamics, sustainable agrifood and energy transition, and the relinking of patterns of food consumption and production in local communities.

Research Background

Agrifood systems in Asia face a myriad of sustainability challenges related to declining environmental health (GHG emissions, resource overuse, pollution, soil fertility), loss of diversity (biological, cultural, knowledge), and deterioration of small-scale farming due to globalizing market forces. At points of consumption, over-reliance on globalized food flows limits consumer agency and decreases food security and sovereignty. Diets increasingly composed of processed foods also negatively impact public health (rise in diabetes, obesity). The ways in which food is provided, consumed and governed need urgent change, but we lack understanding of how agrifood transitions emerge and take root, or of the role of existing and alternative institutions and policy, social practices, future visions, and economic arrangements, in advancing sustainable transitions.

Research Overview and Objectives

The FEAST project takes a transdisciplinary approach to explicate the reality of, and potential for, sustainable agrifood transition in Asia. Individual field sites are located in Japan, Thailand, Bhutan, and China. Taking a lifeworld perspective, we analyze patterns of food consumption, the socio-cultural significance of food-practices, and the potential of consumer-based agency to change deeply held cultural notions and regional food systems. We also develop structural descriptions of the food system, by mapping national, regional, and local production, distribution, and consumption contexts. In combining socio-cultural and structural descriptions of the relationships between production and consumption, we are able to conduct visioning workshops with stakeholders and initiate food citizenship-oriented experiments and actions.

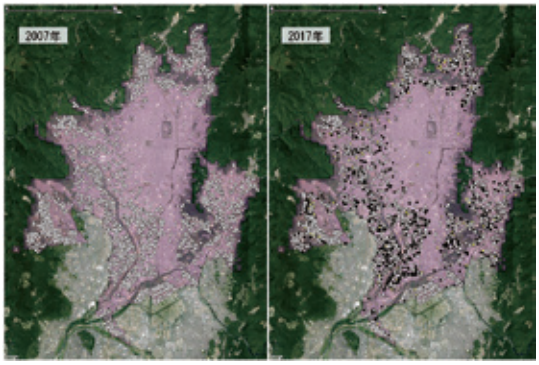

Photo 1 **Urban agricultural land use change in Kyoto City from 2007 to 2017. A loss of 10% of agricultural productive land (1897 ha to 1696 ha) (Colored grids indicate mapped area, white = persistent, black = lost, yellow = gained).**

FEAST's process of co-design and co-production of sustainable food systems seeks to challenge mainstream economic thinking on consumption and growth. In engaging the public in structured debate of societal relationships with food and nature, our project reorients consumers to consider themselves as citizens and co-producers of the foodscapes on which they depend. FEAST seeks knowledge and mechanisms that can redefine the notion of long-term food security.

FEAST Working Groups will produce four types of knowledge relevant to catalyzing agrifood transitions (Figure 1). These are: 1) contextual knowledge of contemporary national, regional, and local food systems (production, distribution, and consumption); 2) co-produced visions of alternative food consumption and production practices and corresponding municipal-level transition plans identifying research, education, and policy needs; 3) modeling- and scenario-based knowledge supporting deliberation and planning processes; and 4) knowledge of two intervention strategies: the social learning dynamics affecting execution and effectiveness of workshop-based consensus-building for collective food action; and the significance of new methods of market transparency (e.g. eco-labels, food impact smartphone apps) in food system change.

Progress to Date

Over the past year, FEAST has made progress on a number of areas of research.

The Ecological Footprint of Japan's food consumption by sector and COICOP category was analyzed, revealing

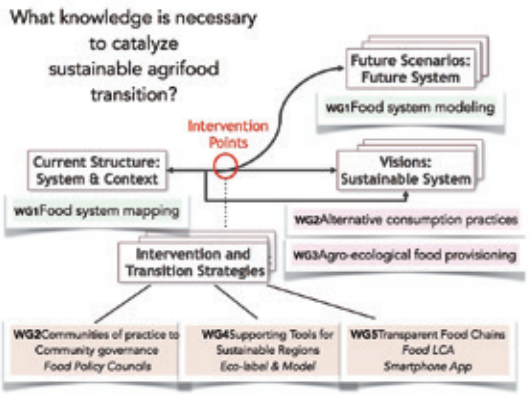

Figure 1 **Diagram detailing how each FEAST working group is organized around the question of "What knowledge is necessary to catalyze sustainable agrifood transition?" Four kinds of knowledge are listed: 1) Current system and contextual knowledge; 2) Visions of sustainable future systems knowledge; 3) Future system scenario knowledge; and 4) Knowledge associated with intervention and transition strategies.**

that importation of animal feed and ingredients processed into ready-to-eat meals sold at convenience store and supermarkets are the most impactful.

Satellite imagery was used to map both formal and informal urban agricultural land use change in Kyoto City. The research found that Kyoto City has lost about 10% of its agricultural productive land (from 1897 ha in 2007 to 1696 ha in 2017) in the last 10 years to housing development (40% post-ag. use) and abandonment (28% post-ag. use), even though it is a shrinking city. (Photo 1)

A comprehensive, multi-method survey of consumer eating habits and orientations to food including a web survey (n=1300) for Kyoto City, Nagano City, and Noshiro City (Akita) was conducted, as well as focus group interviews and photograph records of consumed foods for Kameoka City. Statistical analysis showed a variety of consumer types based on diet diversity and rice acquirement.

Multi-method workshops to envision ideal meals and food systems were held in Kyoto City (visioning, backcasting, and role-playing) and Kameoka City (visioning) with local food-related actors and government officials. Over fifty participants joined altogether. The visions and backcasting results will be included into future scenario modelling next year. (Photo 2)

Focus-group workshops on the future of food-related practices—purchasing, home cooking, and eating out—with "green," "general," and "innovative" consumer groups were conducted in Bangkok. Found that each group had very different ideas about desirable futures for each practice and that consensus building is needed to form concrete policy recommendations.

Municipal agricultural policies and policy plans in Akita, Nagano, and Kyoto were surveyed to gauge policy orientation toward agroecological principles and a "food as a commons" perspective. An intensive analysis of 14 plans found a significant disconnect in municipal and national government policy orientation.

FEAST has finalized research partnerships with Noshiro City, Akita, and Royal University of Bhutan.

Photo 2 **Consumer workshops on visioning food futures, held in Kyoto City (upper left), backcasting group work output (upper right), food system role-playing video game (bottom left), food policy council simulator game (bottom right).**

Photo 3 **Kyoto Farmer's Market and Symposium "Transition to a Sustainable Society with Farmers Markets" held November 23, 2017 at RIHN.**

Photo 4 **FEAST Project Annual Assembly held January 6-7, 2018 at RIHN.**

Sub Leader

TAMURA Norie	RIHN Senior Researcher

Researchers at RIHN

KOBAYASHI Mai	Researcher	**IMAIZUMI Aki**	Researcher
RUPPRECHT, Christoph D. D.	Researcher	**SPIEGELBERG, Maximilian**	Researcher
OTA Kazuhiko	Researcher	**MATSUOKA Yuko**	Research Associate
		KOBAYASHI Yuko	Research Associate

Main Members

TSUCHIYA Kazuaki	The University of Tokyo	**TANAKA Keiko**	University of Kentucky, USA
HARA Yuji	Wakayama University	**SUDO Shigeto**	National Agriculture and Food Research Organization
AKITSU Motoki	Kyoto University	**SHIBATA Akira**	Ritsumeikan University
TACHIKAWA Masashi	Nagoya University	**KISHIMOTO-MO Ayaka**	National Agriculture and Food Research Organization
TANIGUCHI Yoshimitsu	Akira Prefectural University	**INABA Atsushi**	Kogakuin University
NAKAMURA Mari	Nagoya Bunri University		

Sanitation Project

The Sanitation Value Chain: Designing Sanitation Systems as Eco-Community-Value System

Project Leader **YAMAUCHI Taro** RIHN/Hokkaido University

Dr. Taro Yamauchi is a professor at the Faculty of Health Sciences, Hokkaido University. He has a B.S., a M.S. and a Ph.D. in Health Sciences from the University of Tokyo. He does intensive fieldwork in a hunter-gather society, rural villages and urban slums in developing counties to understand lifestyle and health of local populations and their adaptation to their living environments. His research interests also include sanitation and participatory action research involving local children, youth and adults. He is Vice-President of the International Association of Physiological Anthropology (IAPA) and an executive member of International Society for the Study of Human Growth and Clinical Auxology (ISGA).

Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and feces. UN Millennium Development Goals Report 2015 reported that 2.4 billion people are still using unimproved sanitation facilities, including 946 million people who are still practicing open defecation. The developing world still has high under-five mortality and poverty rates. The world's population is estimated to reach approximately 10 billion in 2050, and this population growth will happen mostly in developing countries. At the same time, depopulation and aging are increasing, especially in rural area of developed world, and the financial capability of many local governments—which are key agents in the management of sanitation systems—is getting weaker.

Sanitation systems are essential for promoting public health, preventing environmental pollution, conserving ecosystem functions, and recycling resources. The question of how to handle the waste of 10 billion people is therefore highly relevant to the global environment.

Working hypothesis of the research

The project investigates the following hypotheses:

Hypothesis 1: Current sanitation problems are caused by a dissociation between the value which is provided by the sanitation system and the values of the individual people and/or the community of the people.

Hypothesis 2: Sanitation technologies cannot work well without a social and institutional support system. The mismatch between prerequisites of technologies and local characteristics additionally complicates sanitation issues.

Key concept – Sanitation Value chain as a solution (Figure1)

The project proposes a new concept, the Sanitation Value Chain, which has the following dimensions:

1) Places the values of people and community in the center of discussion, and prepares the sanitation system to correspond to this value chain; 2) Designs the sanitation system by focusing on direct incentives for individual users and communities; 3) Recognizes a sanitation system as an integrated system with social and technical units; 4) Designs the sanitation system by making a good match between social characteristics and prerequisites of technologies

Goals of the project

The goals of this research project are to: 1) propose the concept of Sanitation Value Chain in relation to both developing and developed countries; 2) design several pilot studies demonstrating the significance of societal, academic, and professional involvement in the co-creation of this value chain; and 3) contribute to the establishment of a new interdisciplinary academic foundation regarding on sanitation.

Research topics for achieving the goals

Topic–1 Life and Sanitation: By field survey, we learn about the values of people and the norm for human excreta, and reevaluate the sanitation system in relation to the residents lives.

Figure 1 The Sanitation Value Chain acts within and between other important social values. Example for people in rural area of Burkina Faso (Figure by KATAOKA Yoshimi)

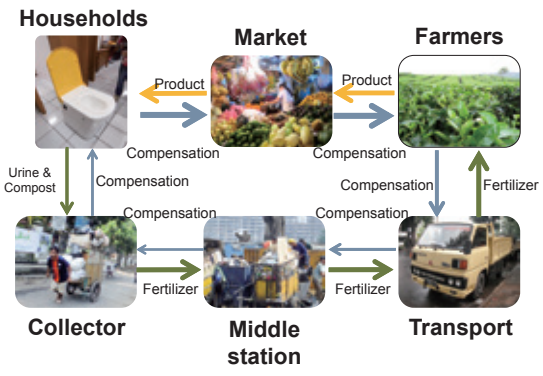

Figure 2 The Sanitation Value Chain acts within and between other important social values. Example in urban area of Indonesia (Figure by USHIJIMA Ken)

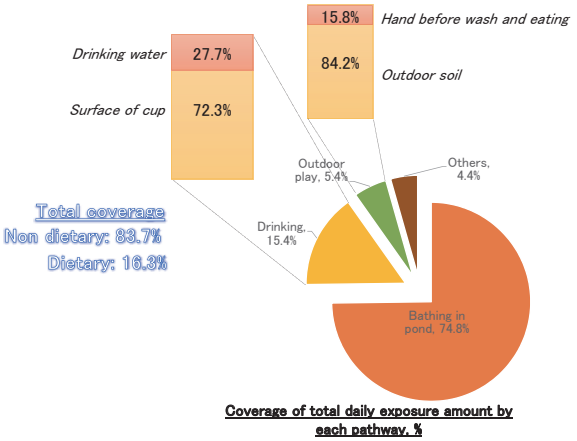

Figure 3 E. coli exposure pathways. Example of measurement in Bangladesh, From: Harada et al. (2017) Fecal exposure analysis and E. coli pathotyping: a case study of a Bangladeshi slum, International Symposium on Green Technology for Value Chains 23-24 October, 2017, Balai Kartini, Jakarta.

Topic–2 Technology: We identify prerequisites of sanitation technologies and reevaluate the value that sanitation will give us. In addition, we develop new sanitization technology to make use of the value chain by understanding the values of people and local conditions.

Topic–3 Co-creation of sanitation value chain: We identify stakeholders and describe the value structures of people and communities, and analyze the hierarchy and structure of stakeholders' value chain and evaluate their affinities. We demonstrate co-creation process of the sanitation value chain.

Topic-4 Visualization: In order to co-create the value chain, it is necessary to make efforts to communicate research results to actors and stakeholders. Utilizing resources and institutional collaboration of RIHN, we will develop a method to express and transmit outcomes using various media.

Research sites

The project is performing field studies at four sites: 1) the rural area in Ishikari River Basin, Hokkaido; 2) the rural area of Burkina Faso; 3) the urban area in Indonesia; and 4) the peri-urban area in Zambia.

Achievements in FR studies

(1) Toilet for recycling resources. We have developed functioning toilet technologies necessary for the sanitation value chain (Figure 2) by making urine in the urban area valuable as fertilizer, the "Toilet that can concentrate urine" and "Toilet that can make phosphorus fertilizer".

(2) Tracking propagation of pathogens. Pathogenic bacteria propagate through various routes. We have developed a molecular biological method of tracking this propagation. In Bangladesh we found that: 1) the most important route of pollution is bathing. The contribution the of water and food route is 16% (Figure 3); 2) the contamination of drinking cups is more important (72%) than of the water itself (28%); 3) the types of E. coli contained in human excreta and drinking water are different.

Photo 1 Meeting with people in Bandung City, Indonesia (Photo by IKEMI Mayu)

Photo 2 Activities of a children's club formed in Lusaka City, Zambia (Photo by Sikopo P. NYAMBE)

(3) Building relationship with people. We have created relationships with locals toward co-creation of sanitation value chains in the fields (Burkina Faso, Indonesia, Ishikari [Japan] and Zambia) (Photo 1 and Photo 2).

(4) A new international academic journal on sanitation. Our project members have begun to edit the international academic journal *Sanitation Value Chain* (ISSN: 2432-5066) in which papers from all over the world are published (Figure 4) Journal website: http://www.chikyu.ac.jp/sanitation_value_chain/journal.html.

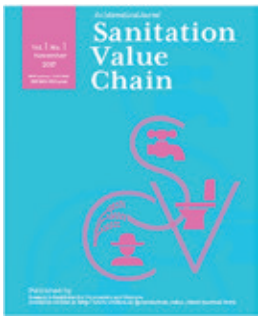

Figure 4 International academic Journal "*Sanitation Value Chain*"

Sub Leader

FUNAMIZU Naoyuki	Muroran Institute of Technology

Researchers at RIHN

HAYASHI Koji	Researcher	**KIMURA Ayako**	Research Associate
NAKAO Seiji	Researcher	**HONMA Saki**	Research Associate

Main Members

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USHIJIMA Ken	Hokkaido Research Organization	**HARADA Hidenori**	Kyoto University
IKEMI Mayu	Sapporo International University	**INOUE Takashi**	Hokkaido University
KATAOKA Yoshimi	Hokkaido University	**SINTAWADANI, Neni**	Indonesian Institute of Science (LIPI), Indonesia
SANO Daisuke	Tohoku University	**NYAMBE, Imasiku Anayaw**	University of Zambia, Zambia
NAKATANI Tomoaki	Yokohama City University	**LOPEZ ZAVALA, Miguel Ange**	Instituto Tecnológico y de Estudios Superiores de Monterrey, Mexico
NABESHIMA Takako	Hokkaido University		

Core Program

The Core Program develops concepts and methodologies for transdisciplinary research to solve global environmental problems in collaboration with society. Core projects develop comprehensive and systematic concepts and methodologies for transdisciplinary research, which are widely applicable to global environmental issues, and accessible to related stakeholders.

Core projects produce conceptual and methodological frameworks together with RIHN Research Projects, based on individual methods, techniques, and tools from the divisions in the RIHN Center. Core projects collaborate with Research Projects, building on the case studies developed by these projects, and develop comprehensive and systematic methodologies beyond an individual Research Program or Project. Core projects also deliver completed concepts and methodology to Research Programs and Projects, the RIHN Center, and related stakeholders.

(See additional Core Program description on page 8.)

Core FS

Co-Design and Stakeholder Engagement According to Geographical Scales

ONISHI Yuko RIHN

Program Director **TANIGUCHI Makoto** RIHN

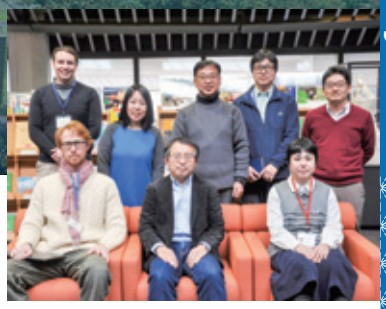
Prof. Dr. Makoto Taniguchi is a hydrologist and a deputy Director-General at RIHN. He received a Ph.D. from The Tsukuba University, Japan in 1987. He is currently the vice president of the International Association of Hydrogeologists and the president of the Japanese Association of Groundwater Hydrology. He has been working on water-related projects around the world, in particular Asia, authoring or co-authoring over 170 peer reviewed articles and 8 books including "Groundwater and Subsurface Environment", "The Dilemma of Boundaries" and "Groundwater as a Key for Adaptation to the Changing Climate and Society".

Researcher

LEE, Sanghyun Researcher

Environmental Traceability Project

Proposal and Verification of the Validity of Isotope Environmental Traceability Methodology in Environmental Studies



Project Leader **TAYASU Ichiro** RIHN

Dr. TAYASU was Assistant Professor at RIHN (2002), Associate Professor at Kyoto University (2003), and is currently a Professor at RIHN (2014). His research focuses on isotope ecology and isotope environmental science.

In this project, we investigate environmental traceability as a key concept needed to solve environmental issues for various stakeholders. Stable isotope ratios of elements, together with concentrations of elements, can trace the flow of matter and chemicals through the environment, better describe ecosystem structure and conditions, and appraise the chemical profiles of food products. Spatio-temporal variation of multiple isotope ratios can be used to study Earth systems operating at local to global scales. This information can serve an important decision-making tool for local people considering water, food and environmental security, all of which are fundamental for the sustainability of human society.

This study seeks to establish methodologies for the use of environmental traceability in environmental studies. A combination of quantitative and qualitative tools, including "Multi-Isoscapes", (the use of multiple elements and isotope ratios together with GIS-based mapping techniques), social surveys, and workshops are deployed to investigate the role of environmental traceability in addressing environmental issues. We hypothesize that the role and perception of traceability methods in transdisciplinary processes will differ among stakeholders and that the co-production of "Multi-Isoscapes" can act as an effective bridging tool for understanding and explaining variation in local environments. The ultimate objective of this research is to demonstrate the effectiveness of multi-isotopic information in solving global environmental issues.

Project research tests (I) the effectiveness of the environmental traceability concept in environmental studies by comparing case studies in which isotopic methods were initiated by local government, citizen groups, and researchers; (II) the extent to which these different stakeholders hold different views of the concepts of food traceability and environmental traceability and the effectivity of these concepts in communicating links between food production and consumption. Field research is taking place in Japan at sites in Ono City, Fukui; Otsuchi Town, Iwate; Saijo City, Ehime; Oshino Village, Yamanashi; the Chikusa river watershed, Hyogo; Lake Biwa and surrounding watershed in Shiga; as well as in the Laguna de Bay and surrounding watershed in the Philippines.

Photo 1 Hongan-Shozu pond in Ono City, Fukui, recharged by ground water

Photo 2 A symposium held in Oshino Village, where we used a questionnaire for studying the effect of environmental traceability methodology

Researcher at RIHN
FUJIYOSHI Lei Researcher

Main Members

NAKANO Takanori	RIHN / Waseda University
SHIN Ki-Cheol	RIHN
YABUSAKI Shiho	RIHN
KONDO Yasuhisa	RIHN
OKUDA Noboru	RIHN
MCGREEVY, Steven R.	RIHN
MORI Seiichi	Gifu Keizai University
YOKOO Yoriko	Doshisha University
YAMADA Yoshihiro	Kagawa University
KAERIYAMA Toshiaki	Gratitude to the Water Foundation
TOKUMASU Minoru	Saijo City Office
OOMORI Noboru	Oshino Village Office
OHKUSHI Ken'ichi	Kobe University
MITSUHASHI Hiromune	University of Hyogo / Museum of Nature and Human Activities, Hyogo
YOKOYAMA Tadashi	Hyogo prefectural Ako School for Students with Special Needs

Open Team Science Project

Information Asymmetry Reduction in Open Team Science for Socio-environmental Cases

Project Leader **KONDO Yasuhisa** RIHN

Yasuhisa Kondo has worked for four years as an associate professor at the Information Resources Division of the RIHN Center. Originally, he studied archaeology and geographical information sciences (The University of Tokyo PhD 2010). He is currently interested in open science, participatory action research, and transdisciplinary research promotion for environmental archaeology and socio-environmental cases. He is also coordinating an archaeological mission to Oman.

This Core Project develops a theory and methodology to reduce information asymmetry between actors in team-based science for socio-environmental cases.

Social issues caused by environment deterioration are often so complex that solution-oriented research is team-based and involves research experts from different domains in interdisciplinary (ID) projects as well as practitioners such as governments, funders, industries, non-profit organizations, and members of civil society in transdisciplinary (TD) projects. Such team-based science is often disrupted by information asymmetry—a condition in which one party has relevant information while the others do not—between participants, as they are actors with different values, knowledge, and socioeconomic status. This asymmetry leads to different understandings of focal issues and other actors.

In our working hypothesis, information asymmetry can be reduced through a combination of: (1) diversion, or an approach to divert a wicked problem between stakeholders to a sharable object or goal for which all actors, including the unengaged public, can work together; (2) participation and empowerment of marginalized (or 'small voice') actors; (3) fair data visualization; and (4) dialogue. These approaches work to re-calibrate the influence of dominant actors such as principal investigator (PI) in ID projects and research experts, funders, and policy makers in TD projects.

As an example of the holistic approach to diversion, ID projects may employ a "switched explanation" in which particular research results are explained by counterpart experts. Civic tech, or participatory co-production of solutions for local issues by self-motivated civic engineers using information and communication technologies and open data, is applied where appropriate in the TD cases. The FAIR data principle (that data is Findable, Accessible, Interoperable, and Reusable) is introduced to encourage researchers to provide their data to the public (the FAIR principle is useful when researchers are reluctant to follow the open data license, in which 'anyone can freely access, use, modify, and share data for any purpose' *in sensu stricto*).

This working hypothesis is tested in ID, TD, and ID-TD transitional case studies, including community-based waterweed recycling in the Lake Biwa catchment, Japan. The effects of problem diversion on project progress and participants' perceptual transformation are measured through participatory observation, semi-structured interviews, and periodical questionnaire surveys. Based on these assessments, the hypothesis is improved and tested again. This Hypothesis-Practice-Assessment Cycle is repeated flexibly to improve the methodology, which co-evolves and integrates the open science and TD theories as a new paradigm for environmental studies.

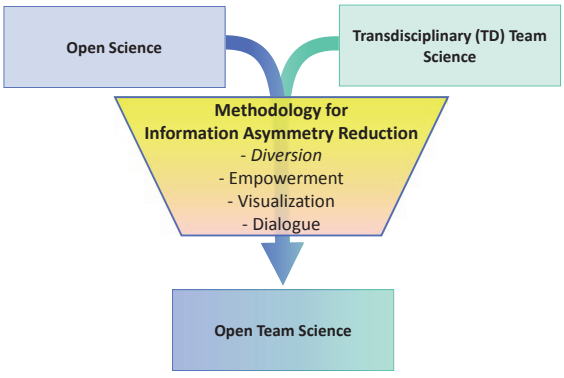


Figure 1 **This Core Project integrates open science and transdisciplinary team science theories to create an open team science methodology.**

Photo1 **Graphic recording works as a method for fair data visualization and dialogue in civic tech workshops.**

Main Members

KANO Kei	Shiga University
KUMAZAWA Terukazu	RIHN
NAKASHIMA Ken'ichiro	Hiroshima University
ONISHI Hideyuki	Doshisha Women's College of Liberal Arts
OSAWA Takeshi	Tokyo Metropolitan University
NAKATSUKA Takeshi	RIHN
OKUDA Noboru	RIHN
YAMAUCHI Taro	RIHN/Hokkaido University
A project researcher to be appointed	

Above: ABE Ken-ichi, *Tanokamimodoshi*, Satsumasendai, Kagoshima, Japan
Bottom: OSHIUMI Keiichi, A train running through Maeklong Market, Thailand