Human-Environmental Security in Asia-Pacific Ring of Fire: Water-Energy-Food Nexus

Project Leader **ENDO Aiko** RIHN

Associate professor Aiko Endo studies the economics of fisheries as well as coastal and marine policy. Her interdisciplinary and multi-sectoral approaches to Integrated Coastal Management (ICM) in Japan have generated national policy proposals. Her research seeks interdisciplinary and transdisciplinary approaches to the co-design and co-production of governance structures that can solve environmental issues by linking local, national, regional, and global policy spheres.

Research objectives and background

Climate change and social change, including accelerating development, urbanization, and globalization are increasing pressure on water, energy and food resources, increasing the number of tradeoffs and potential conflicts among these resources that have their complex interactions. The Global Risks Interconnections Map published by the World Economic Forum in early 2016 highlights the global risk posed by linked food and water crises and energy price shocks. In order to address these issues, the objectives of the project are to understand the complexity of the water-energy-food (WEF) nexus system and to create policy options to reduce trade-offs among resources and to alleviate conflicts of resource users using scientific evidence and under assumptions of uncertainty to maximize human-environmental security. The project also contributes solutions to local and global environmental problems by contributing to global research networks associated with the Future Earth platform and the U.N. Sustainable Development Goals.

Research methods and structures

The project involves 60 researchers from different disciplines and five countries, including Indonesia, the Philippines, Canada, Japan and the USA. Five research groups carry out the following tasks: 1) the Water-Energy Nexus Group conducts biophysical measurement and analysis using space satellites, geothermic, and hydrogeological techniques; 2) the Water-Food Nexus Group conducts biophysical measurements and analyses using geochemical, coastal oceanographic, geophysical, hydrologic, and ecological methods, including isotopic tracers; 3) the Stakeholder Analysis Group conducts stakeholder and social network analyses, community surveys, and scenario planning based on sociology, economics, and behavioral science approaches; 4) the Socio-culture of Resource Usage Group develops the science-policy interface based on its examination of the socio-cultural history of groundwater use; and 5) the Interdisciplinary Group conducts the research with a mission to: i) identify research problems; and ii) determine the methods and/or create new discipline-free methods based on synthesizing and harmonizing team-based production, collected from individual scientists in different disciplines from each team in order to assess human environmental security. In addition, the team further developed these approaches to incorporate non-scientific/-disciplinary views on the analyses; and iii) design a nexus system.

Figure 1 Target research sites

http://www.chikyu.ac.jp/rihn_e/project/R-08.html
http://www.chikyu.ac.jp/wefn/index.html

Research activities and findings

In order to analyze the water-energy nexus we are collecting groundwater samples from observation wells by depth for monitoring the groundwater level in Otsuchi. We also calculated the potential of using groundwater as a source of thermal energy in Obama. In Beppu, the subsurface environment, including flow of groundwater and hot springs, have been clarified by gravity measurement.

The Water-Food Nexus Group identified the location of submarine groundwater discharge at Obama and Beppu bays, and estimated the supply of nutrients conveyed from land to ocean by groundwater. Stakeholder analysis of hot spring resources also clarified key issues related to future scenarios and social change.

The Interdisciplinary Group will continue to develop integrated methods, including models of Beppu and Otsuchi, Japan, Pajaro Valley, California, and British Columbia, Canada. This group is also designing a nexus system at the local scale to understand the complexity of the nexus system and establish a clear definition of the nexus concept.

For collaborative scientific activities with society, we designed lectures open to local citizens, also conducted a participatory survey on hot springs with local residences and stakeholders in Beppu. We developed a web page, "spring map", in order to share the results of our groundwater survey. Such activities with local governments and private sector raised awareness of nexus issues.

Future research will improve scientific understanding of the complexity of the water-energy-food nexus, and attempt to ease social conflicts by promoting dialogue and cooperation with stakeholders. Finally, we will contribute to policy by suggesting ways to reduce trade-offs among the three nexus resources.

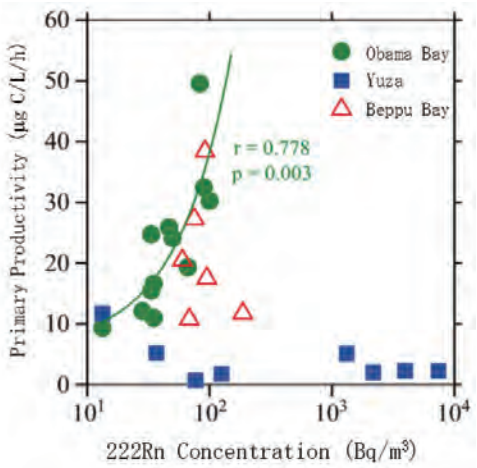

Figure 2 Relationship between submarine groundwater discharge and primary productivity (Sugimoto et al. 2017)

Photo 1 Participatory survey on hot springs in Beppu

Expected results

1. To define the academic nexus concept.
2. To understand the complexity of the water-food-energy nexus system, and create visualizations of the linkages between events using ontology-based systems; to identify trade-offs and efficient resource uses; to define the academic concept of nexus, contribute to scenario planning, and design a nexus system.
3. Preparation of policy-relevant future nexus issue scenarios through collaboration with stakeholders.
4. Development of localized studies that can be up-scaled and produce policy-relevant results; improvement of networking with stakeholders and researchers addressing nexus issue nationally and internationally.

Photo 2 The nexus project meeting in Otsuchi Town

Project Researchers at RIHN

OH Tomohiro	Project Researcher
MASUHARA Naoki	Project Researcher
OKAMOTO Takako	Project Research Associate
HONDA Hisami	Project Research Associate
TERAMOTO Shun	Project Research Associate

Main Project Members

TANIGUCHI Makoto	RIHN
FUJII Masahiko	Hokkaido University
SHOJI Jun	Hiroshima University
BABA Kenshi	Tokyo City University
OHSAWA Shinji	Kyoto University
TAHARA Daisuke	Fukui Prefectural University
KAWAMURA Tomohiko	The University of Tokyo
DELINOM, Robert M.	Indonesian Institute of Sciences, Indonesia
ALLEN, Diana M.	Simon Fraser University, Canada
SIRINGAN, Fernando P.	University of the Philippines Diliman, Philippines
GURDAK, Jason	San Francisco State University, USA