

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

M. Taniguchi, A. Endo, RIHN Research Institute for Humanity and Nature, Kyoto, JAPAN; J.J. Gurdak, San Francisco State University, San Francisco, California, UNITED STATES; D.M. Allen, Simon Fraser University, Vancouver, British Columbia, CANADA; F. Siringan, University of Philippines, Manila, PHILIPPINES; R. Delinom, LIPI, Bogor, INDONESIA; J. Shoji, Hiroshima University, Hiroshima, JAPAN; M. Fujii, Hokkaido University, Sapporo, JAPAN; K. Baba, Hosei University, Tokyo, JAPAN



## Abstract

In this research project, we intend to establish a method to manage and optimize the human-environmental security of the water-energy-food nexus by using integrated models, indices, and maps as well as social and natural investigations with stakeholder analyses. We base our approach on the viewpoint that it is important for a sustainable society to increase human-environmental security with decreasing risk and increasing resilience by optimizing the connections within the critical water-energy and water-food clusters. We will also take a regional perspective to address these global environmental problems. The

geological and geomorphological conditions in our proposed study area are heavily influenced by the so-called "Ring of Fire," around the Pacific Ocean. Within these areas including Japan and Southeast Asia, the hydro-meteorological conditions are dominated by the Asia monsoon. The populations that live under these natural conditions face elevated risk and potential disaster as negative impacts, while also benefitting from positive ecological goods and services. There are therefore tradeoffs and conflicts within the water-energy-food nexus, as well as among various stakeholders in the region.

## Research objectives and background

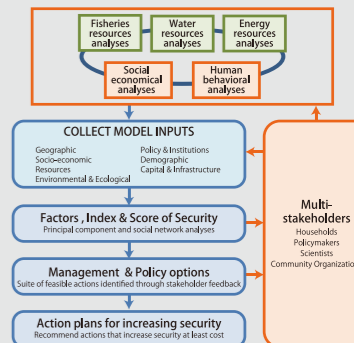
Climate change and economic development are causing increased pressure on water, energy and food resources, presenting communities with increased levels of tradeoffs and potential conflicts among these resources. Therefore, the water-energy-food nexus is one of the most important and fundamental global environmental issues facing the world. As water is the central matter within this cluster, we will focus on the inherent tradeoffs between water and food, and water and energy. For the purposes of this project, we define human-environmental security as the joint optimization between human and environmental security as well as the water-energy and water-food connections. To optimize the governance and management within these inter-connected needs, it is desirable to increase human-environmental security by improving social managements for the water-energy-food nexus.

The objective of this project is to maximize human-environmental security (minimize the vulnerability) by choosing management structures and policies that optimize both the water-food and water-energy connections in Asia-Pacific coastal regions. We define joint security approach as optimized policy for both critical water clusters. Optimal policies will develop joint security approaches for human-environmental security in the coastal region of the Ring of Fire, including stakeholders and decision-makers.

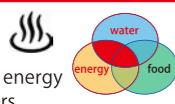
## Research methods and organization

Five different interdisciplinary approaches, scales and clusters will be used in this investigation: (1) Environmental governance, science in/for society, and co-design/co-production approaches, in particular emphasizing regional scale stakeholders such as GEC (Global Environmental Change) Asia Platform; (2) Biophysical measurements/analyses within the water-food (e.g., fisheries resources)

nexus by using state-of-the-art geochemical, coastal oceanographic, geophysical, hydrologic, and ecological techniques including isotopic tracers to evaluate the linkages between land and ocean; (3) Biophysical measurements/analyses of the water-energy nexus by using state-of-the-art space satellite, geothermic, and hydrogeological techniques to evaluate linkages between water and energy; (4) Social measurements/analyses of the water-energy-food relationships by use of community surveys, cost-benefit/efficiency analysis, and environmental valuation, based on sociology, economics, anthropology, psychology, and behavior-science methodologies; and (5) Development of integrated indicators/indices and network analyses based on principal component analyses (PCA), social network analyses, and factors weights determined by feedback from stakeholder meeting/workshops.

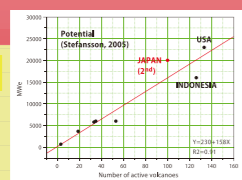
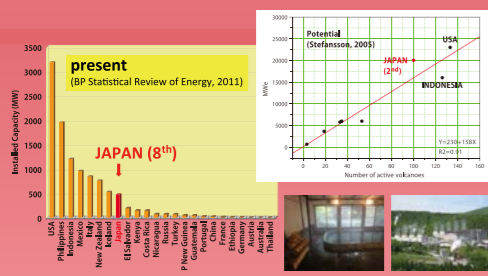


## Water-Energy Nexus



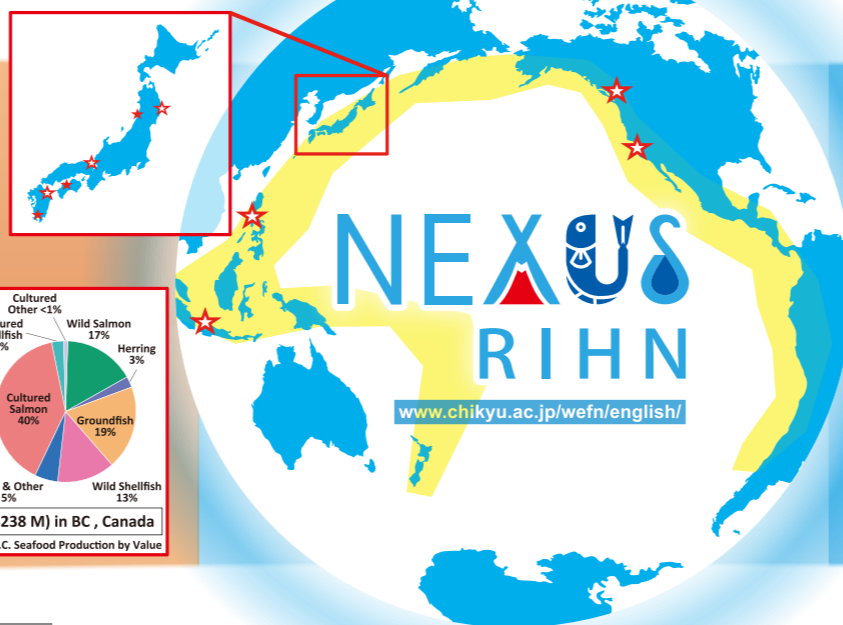
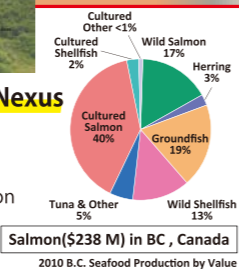
- Tradeoff between water and energy
- Conflict between stakeholders

Which benefit should we choose for sustainable society?



## Water-Energy-Food Nexus

- Hydropower generation VS Fisheries (Salmon) production VS Environmental flow



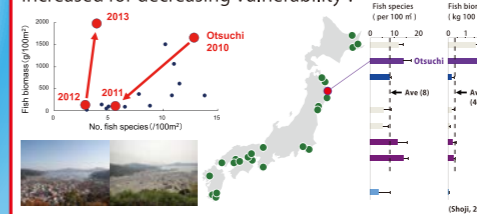
## Water-Food (fishery production) Nexus

Linkage between land & ocean through water & nutrient transports

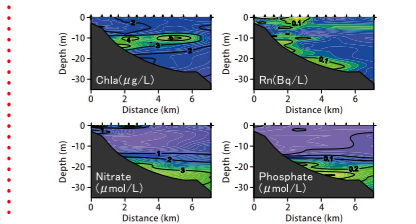
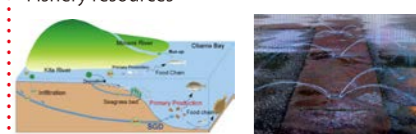


- Higher curvature coast:
  - higher nutrient convergence
  - higher risk like tsunami

Which component of security should be increased for decreasing vulnerability?



Snow melting system using GW (Groundwater as thermal energy) vs Fishery resources

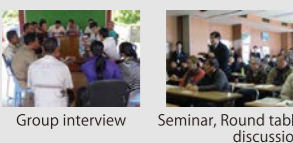


## Social science analyses

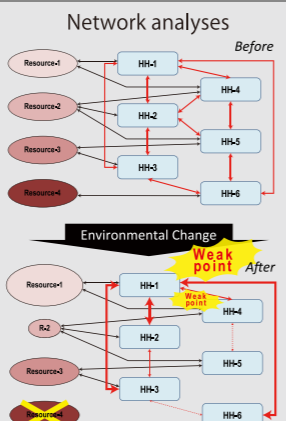
Analyses for interactions between factors which are closely related to Security



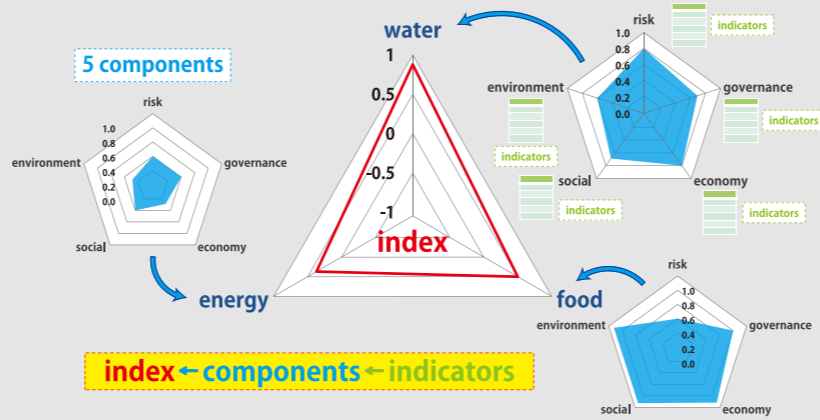
Socio-economic & Cultural evaluations



Results, problems, possibilities



## Integrated Indices of security



## Expected results

1. Suggested guidelines to increase environmental security and reduce conflicts related to the water-energy-food nexus
2. Recommendations for decreasing coastal vulnerability due to the separation of land and ocean governance
3. Policy and governance structure recommendations for improved water management
4. Suggestions for sustainable environmental management of the water-energy-food nexus in the Asia-Pacific region.

