

## Optimal governance for water-energy-food nexus in Asia-Pacific region

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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 governance and management within these inter-connected needs, it is desirable to increase human-environmental security by improving social management for the water-energy-food nexus. In this research project, we intend to establish a method to manage and optimize the human-environmental security of the water-energy-food nexus. We base our approach on the viewpoint that it is important for a sustainable society to increase human-environmental security and decrease vulnerability by optimizing the connections within the critical water-energy and water-food clusters.

As the interim results of the project, we have evaluated the potential ground heat storage, geothermal energy, micro-hydro power in Japan and Philippines as the capacities for the tradeoff and the potential conflicts between water and energy. Relationships between fishery production and fishery diversity, between diversity of the water discharged from land to the ocean and fishery production/diversity, water as well as connectivity between land and ocean as the resilience to the risks such as tsunami, and social demographic change such as decreasing labors and increasing demand of energy.

Stakeholder analysis and social network analysis have been made to analyze the common interests/disputes among water-energy-food nexus and stakeholder behavior changes by using local stakeholder meetings as co-design and national level discussion on web about water-energy food nexus such as geothermal energy development and hot spring preservation. Framing of the integrated index, integrated maps, integrated physical models including water, nutrients, and biomass/fishery production have been also making for helping optimal policy selections. Integration of the local-national scale of the stakeholders have been also making based on involvements of new water act in Japan and California sustainable groundwater act as well as participatory web as co-monitoring of local environments such as natural springs. Linkage to the global nexus platform has been also made to Bonn Nexus, North Caronia Nexus, World Water Week, and others.

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