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

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The objectives of this research are to understand the complexity of the water-energy-food (WEF) nexus system and to create scenarios and 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. Five different interdisciplinary approaches, scales and clusters will be used in this investigation: 1) the science in/for society; 2) the water-energy nexus; 3) the water-food (e.g., fisheries resources) nexus; 4) the stakeholder analysis; and 5) the interdisciplinary study.
A primary challenge of this nexus study is to analyse the interlinkages between groundwater and fisheries production, regarding the hypothesis that the flow of nutrients from land to ocean affects the coastal ecosystem. This suggests that water use for producing and/or consuming food and/or energy on land might affect fisheries production in coastal areas. To examine this theory, we address two primary objectives; 1) to understand the complexity of the water-energy-food (WEF) nexus system since the relationships of all three resources are interrelated and interdependent; and 2) under scientific evidence and scientific uncertainty to create scenarios and policy options to solve the identified nexus problems, that is, to reduce the number of tradeoffs among three resources and to mitigate potential conflicts among these resource users through transdisciplinary approaches.
(To understand the complexity of WEF nexus system)
At the local level of WEF in Beppu, hot spring resort area, a finding of the WEF nexus shows that changes in the heat environment caused by hot spring drainage water from resorts and power generation affect river ecosystems, including non-native Tilapia habitat. As for the interlinkages between groundwater and fishery production, changes in submarine ground water (SGD) rates cause change in nutrients flux, which results to change in primary production, and finally leads to change in fishery resources. We found that there was a positive correlation between phytoplankton primary production and radon concentration, as a groundwater tracer of SGD in Obama Bay. Regarding the relationship between SDG and nutrient flux, we found nutrients supplied from the SGD have a high contribution to primary production. As a result of addressing SDG and fisheries production, we discovered that more fishes were found near SGD. We demonstrated the interlinkages between groundwater and fishery production.
(Developing methods for interdisciplinary and transdisciplinary studies)
We designed WEF nexus system integrating methods such as computer science, ontology engineering and economic tools to understand and visualize the nexus system in Beppu to contribute to scenario planning and define the academic concept of nexus. Regarding stakeholder analysis, we identified governance issues for the coexistence between hot spring energy development and hot spring resource conservation. They also visualized the social network of hot spring stakeholders, who shared same interests in Beppu. Regarding scenario planning, we identified stakeholder interests, held stakeholder meetings and expert meetings. We will provide scenarios and develop action plans by collaborating with stakeholders, and experts next year.

Keywords: water-energy-food nexus, interdisciplinary, transdisciplinary, coastal ecosystem

