

## Water-energy-food nexus: Effects of groundwater use as heat energy on fishery resources in the coastal area

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Water, energy, and food are the most fundamental resources for human well being and a sustainable society. Demands for these resources are estimated to drastically increase in the near future because of increases in population and changes in lifestyle. These three resources have also been inter-related, and make a "nexus" which causes tradeoff between resources and conflict between stakeholders. In this study, the groundwater-energy-fishery nexus is analyzed and evaluated in the snowy area of Obama City, Fukui Prefecture, Japan. The objective of this study is to evaluate the effects of groundwater used as heat energy for the melting of snow accumulated on roads, on fishery productions in the coastal area. The submarine groundwater discharge which carries nutrients into the ocean is reduced by excess groundwater pumping for melting snow. Positive correlation has been found between primary production rates in Obama Bay and radon concentrations which show the magnitude of the submarine groundwater discharge. Therefore, the increase in groundwater pumping on land may reduce fishery productions in the ocean. Results of 3D numerical simulations of the basin scale groundwater model show a reduction of SGD by 5 percent due to an increase in groundwater pumping by 1.5 times. This reduction of SGD caused a 3.7 ton decrease in fishery production under the aforementioned assumptions. The groundwater-energy-fishery nexus was found in Obama Bay, Japan and the tradeoff between water and food was evaluated.

Keywords: Water-energy-food nexus, submarine groundwater discharge, land-ocean interaction