



## **Impact of groundwater use as heat energy on coastal ecosystem and fisheries**

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Demands for groundwater as a heat energy source to melt snow is increasing in many coastal snowy areas in Japan because of the lack of laborers for snow removal and the abundance of groundwater resources. The temperature of groundwater is relatively higher in winter than that of the air and river water, therefore it is a useful heat source to melt snow. However, groundwater is also beneficial for the coastal ecosystem and fishery production because of the nutrient discharge by submarine groundwater discharge (SGD), which is one of the water and dissolved material pathways from land to the ocean. Therefore, groundwater is involved in the tradeoff and management conflict existing between energy and food (fisheries). In this study, the impact of groundwater, used as a heat energy source for the melting of snow accumulated on roads, on the coastal ecosystem and fisheries has been analyzed in the snowy areas of Obama City, Fukui Prefecture, Japan. 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 reduces fishery production 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.