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Inclusive Environmental Impact Assessment for Ocean Nutrient Enhancer

[Koji Otsuka](#) and [Kazuyuki Ouchi](#)

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Summary: Deep ocean water (DOW) is cold, nutrient-rich and pathogen-free seawater found at depths of several hundred meters or more. Artificial upwelling of DOW may significantly enhance marine primary production. The fisheries agency of Japanese government has undertaken an *in-situ* experiment of a prototype ocean nutrient enhancer, named TAKUMI, which is driven by a conventional diesel engine, in Sagami Bay. They have also designed a large-scale practical machine, which is driven by an ocean thermal energy conversion (OTEC) engine. In this paper, inclusive impact assessments of TAKUMI and the practical machine, which evaluate environmental and economical sustainability by an integrated evaluation indicator using ecological footprint and gross domestic product, were performed. The assessment results show that renewable energy sources should be employed to operate the system in order to realize sustainable artificial upwelling. The ecological footprint per unit biomass of fish production by the practical machine is much lower than that of land-based commercial meat productions, such as beef, pork and chicken.

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