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How does anthropogenic nitrogen input affect the nutrient dynamics and food web structures?

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In last five decades, impacts of anthropogenic nutrient inputs on river ecosystems have continuously been a major concern for the governments and residents of the catchments in Japan. Major sources of anthropogenic nitrogen (N) include leachate from forest ecosystem, surplus fertilizers and sewage. Impacts of anthropogenic N inputs on nutrient dynamics and food web structures were investigated using stable N isotope techniques in the Arida river catchment, Japan. Riverine survey utilizing 5 regular sampling points showed that δ^{15}N of nitrate (NO_3^-) increased from forested upstream (˜2 ‰) to the downstream (˜7 ‰) due to the sewage loads and fertilizer effluents from agricultural area. Correspondingly the δ^{15}N of benthic algae and aquatic insects increased toward the downstream. This indicates that primary producers of each reach strongly relied on the local N sources and it was utilized effectively in their food web. Simulation using a GIS based mixing model considering the spatial distributions of human population density and fertilizer effluents revealed that strongest impacts of N inputs was originated from organic fertilizers applied to orchards in the middle to lower parts of catchment. Differences in δ^{15}N between primary producers and predators were ˜6-7 ‰ similarly at all sampling points. Food web structural analysis using food network unfolding technique based on observed δ^{15}N suggested that the structure of nutrient pyramid did not differ significantly along the riverine positions, while the members of species in each trophic revel changed and the impact of anthropogenic N input was visible along the river.

Keywords: river ecosystem, nitrogen input, stable isotope, food web