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Title	COD (Chemical Oxygen Demand) Across Japan's Coastline : A Study of Spatiotemporal Trend and Environmental Drivers
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Description	この博士論文の全文は利用可能日以降に公開されます。利用可能日以前の閲覧方法は https://www.lib.hokudai.ac.jp/dissertations/copy-guides/ をご参照ください。
Degree Grantor	北海道大学
Degree Name	博士(水産科学)
Dissertation Number	甲第16565号
Issue Date	2025-09-25
DOI	https://doi.org/10.14943/doctoral.k16565
Doc URL	https://hdl.handle.net/2115/98175
Type	doctoral thesis
File Information	Chalvin_Putra_Rura_abstract.pdf, 論文内容の要旨 https://creativecommons.org/licenses/by/4.0/



学位論文内容の要旨

Dissertation Abstract

博士の専攻分野の名称：博士（水産科学）

氏名：Chalvin Putra Rura

学位論文題目
Title of dissertation

COD (Chemical Oxygen Demand) Across Japan's Coastline: A Study of Spatiotemporal
Trend and Environmental Drivers
(日本の沿岸域における COD（化学的酸素要求量）：時空間変化と環境要因に関する研究）

The Japanese government has implemented various policies and monitoring programs to mitigate organic matter pollution in coastal waters, particularly by limiting wastewater discharges. Chemical oxygen demand (COD), a key indicator of organic pollution from domestic and industrial sources, plays a central role in assessing the effectiveness of these measures. Yet, increasing COD trends are still observed in certain coastal regions, raising concerns. Since COD also captures organic matter from natural sources such as phytoplankton and terrestrial runoff, environmental factors—particularly climate conditions—may also contribute to these trends.

This study investigated long-term COD trends in Japan's coastal waters and explored potential environmental drivers using the Mann–Kendall test and dynamic factor analysis (DFA). The analysis consisted of three components: (1) examining the spatial and temporal variability of COD trends across major designated bays and broader coastal regions; (2) focusing on Hokkaido to evaluate COD spatio-temporal variability and its connections with population, agricultural, livestock, and fishery activity; and (3) conducting a case study of Hakodate Bay to assess the role of climatic variables in driving COD trends.

The first analysis revealed that while COD trends in Japan's three major bays generally show a decreasing pattern—suggesting improvement—temporal variability exhibited spatial differences. These differences can be attributed to the locations of monitoring stations, which are typically near shorelines, port areas, and river mouths. At a broader scale, trends along the Japan Sea and the southwest Pacific coast displayed regional variation, indicating that environmental influences are more localized (e.g., river inflow) rather than driven by large-scale factors (e.g., ocean currents).

The second analysis, focused on Hokkaido, identified a spatial divide, with decreasing COD trends in the west and increasing trends in the east. In certain areas, such as Kushiro and Abashiri, high COD levels and increasing trends were associated with agricultural and livestock related industries. This relationship appears to be region-specific and does not fully account for the overall pattern observed across Hokkaido.

The Hakodate Bay case study revealed rising COD levels, with DFA results suggesting that air temperature and wind speed were potential drivers. In contrast, trends in total nitrogen and total phosphorus in the bay showed weak associations with climatic variables. These findings support the idea that COD trends were partially influenced by climate factors, which may complicate efforts to evaluate the effectiveness of pollution mitigation through COD monitoring alone.

In conclusion, this study underscores the spatial difference in COD trends across Japan's coastal waters and highlights the need for region-specific assessments for better understanding and management of organic matter pollution.

Keywords: COD (Chemical Oxygen Demand), long-term trend, coastal area, environmental factors.