Modeling the Effects of Climate Change and Land Use changes on the Water Quality of Lake Diefenbaker

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The negative impact of anthropogenic activities and climate change degrades freshwater quality, leading to limited access to this critical resource. A key source of fresh water for the people of Saskatchewan is Lake Diefenbaker, an artificial lake and reservoir that was constructed on the South Saskatchewan and Qu'Appelle Rivers. Climate and land-use changes are affecting hydrological processes and nutrient dynamics in this lake. Additionally, planned infrastructure projects, such as Lake Diefenbaker irrigation project, may further threaten water security of this lake. In this study, a two-dimensional water quality and hydrodynamic model is used to identify changes in temperature and water quality in this lake under different climate change scenarios. The key water quality variables include total phosphorus (TP), total nitrogen (TN), phosphate (PO4-P), total ammonia (ammonium NH4+N), nitrate (NO3-N), dissolved oxygen (DO), dissolved organic carbon (DOC), total dissolved solids (TDS), and chlorophyll-a (Chl-a). The climate model ACCESS-CM2, which is part of the Coupled Model Intercomparison Project Phase 6 (CMIP6) ensemble, will be utilized to simulate the effects of climate change on Lake Diefenbaker under two Socio-Economic Pathways (SSP2-4.5 and SSP5-8.5). These pathways represent plausible future scenarios of human development and greenhouse gas emissions. By incorporating these scenarios into the model, the study will explore how changes in temperature and nutrient dynamics will affect the water quality of different lake zones and depths. The results of this study will provide a lens for decision-makers to the future status of this lake under different water management and climate change scenarios. Ultimately, this research aims to promote the sustainability of Lake Diefenbaker and water security in downstream river basins by identifying and mitigating the impacts of climate change on freshwater resources.