

# Assessing the Impacts of Sequential Dam Development on the Blue Nile During Prolonged Drought

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## Abstract:

Conflicts frequently emerge among nations regarding the allocation of transboundary river resources, particularly in developing regions where water is essential for agriculture, energy, and domestic use. The upstream dam development in the Eastern Nile River basin has heightened scientific and public concern about the urgent need for quantitative management of water and hydropower resources, especially during extended drought periods. In this study, we assess the impact of both collaborative and non-collaborative operational scenarios of two proposed dams upstream of the Grand Ethiopian Renaissance Dam (GERD) during prolonged droughts, using the Eastern Nile RiverWare Model (ENRM). Our primary findings indicate that under a collaborative operation scenario, the average annual hydropower generation on the Blue Nile River could increase by approximately 50%, while this could lead to a significant increase in the downstream water budget deficit at the High Aswan Dam by nearly 87 billion cubic meters (bcm) during prolonged drought. Conversely, under suggested collaborative scenarios, the total downstream water budget deficit could be reduced by approximately 34% (to around 57 bcm), with upstream hydropower generation decreasing by only about 4%, compared to the non-collaborative scenario. Our findings underscore that cooperative dam operation can simultaneously advance the hydropower development objectives of the Nile's upstream regions which, at the same time safeguarding the water security of downstream nations.

**Keywords:** Transboundary River; Eastern Nile Basin; Hydropower dams; Water Resources.