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Editorial: Balancing Hydropower and Freshwater Environments in the Global South

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Editorial on the Research Topic

Balancing Hydropower and Freshwater Environments in the Global South

The construction of hydropower dams is growing rapidly across the southern hemisphere and developing world (Winemiller et al., 2016), with most new dams being built in South America and Asia (Baumgartner et al., 2014). Freshwater ecosystems are tremendously impacted by dam construction and reservoir operation (Brown et al., 2014). For instance, the Living Planet Index indicates an 89% loss in biodiversity in freshwater environments globally arising from all forms of river development (Deinet et al., 2020). Dams alter flow (Timpe and Kaplan 2017) and sediment regimes (Wang et al., 2018), which impact ecosystem services, wetland conservation, water quality, land fertility, and fisheries productivity (Reilly et al., 2018).

Despite its known impacts, hydropower is generally considered a relatively cheap and climate-friendly source of energy (Athayde et al., 2019). It has been shown, however, that hydropower operations can have high green-house gas emissions, especially in the tropics (Almeida et al., 2019). Regardless, sustained economic and population growth are fuelling continued dam construction, often at the expense of other ecosystem services. Until recently, most research on the connections between dams and freshwater ecosystems has focused on the Northern hemisphere; this research topic seeks to address this gap. The 12 articles in the research topic ask several key questions related to the hydrological, ecological, social, and economic values of rivers and dams in the southern hemisphere: What ecosystem services are gained and lost with hydropower development? Over what time frame are impacts realized? Who "wins" and "loses" as these trade-offs are made?

Several studies presented evidence that hydropower operations caused substantial ecosystem impacts beyond the main river channel. Three papers quantified the ecological impacts of dam operations on connected wetland systems, such as the Pantanal (Ely et al.; Figueiredo et al.; Jardim et al.). Additionally, Fantin-Cruz et al. showed that dam-induced reductions in river flow reduced the frequency of wetland connectivity events. This disconnection had the additive effect of interrupting nutrient-rich sediment transport (Oliveira et al.) and reducing fisheries recruitment (Oliveira et al.). Taken together, these six papers connect hydrological alteration, sediment and nutrient dynamics, and fisheries impacts, highlighting the need for multi- and interdisciplinary approaches to fully understand dam-induced impacts on ecosystems.

Four papers addressed the impacts of different dam types and modes of operation. Developing operational protocols that reduce hydropeaking was identified as a straightforward way to mitigate the most undesirable hydrological, geomorphological, ecological, and social effects on downstream reaches (Almeida et al.). As noted by Doria et al., hydropeaking operations severely impact riverine (human) communities that are dependent on fisheries resources. In addition, there was a suggestion

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that converting conventional hydropower projects to "pumped hydropower" initiatives, while potentially beneficial economically, could create the unfavorable outcome of transferring invasive species (Doyle et al.). Finally, despite their relatively "small" scale, the planned proliferation of low-head hydropower dams is expected to have large social and ecological impacts in Uganda (O'Brien et al.), which these authors suggest may be partially mitigated by the adoption of locally relveant environmental flow practices.

Finally, two papers focused on dam planning. Campbell and Barlow and Gonzalez et al. suggested that improved pre-construction planning is fundamental to enhancing the ecological and social benefits of hydropower in tropical systems. Unfortunately, but perhaps unsurprisingly, stakeholders reported that dam companies prioritize decisions that maximize profits, as opposed to mitigating impacts. Providing economically sustainable outcomes, while minimizing environmental impacts, thus remains a major challenge (Silva et al., 2018). Regardless of region and dam type, it is clear that engineers, developers, planners, ecologists, and communities must work together and consider whole-catchment effects to bring about the best outcomes for people and rivers (Baumgartner L. et al., 2014).

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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The editors of this research topic hope you will enjoy reading these articles, which increase the overall awareness of hydropower and freshwater interactions in the Global South. We would like to thank all the contributors and the Frontiers staff who have helped to make this research topic a success.

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