

EGU22-3040, updated on 11 Apr 2022

<https://doi.org/10.5194/egusphere-egu22-3040>

EGU General Assembly 2022

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



Dynamic Water-Energy-Food nexus management in transboundary river basins incorporating water infrastructure operation and demand control

Guang Yang, Matteo Giuliani, Elena Matta, Veronica Piuri, and Andrea Castelletti

Department of Electronics, Information, and Bioengineering, Politecnico di Milano, Milan, Italy

Water resources infrastructure plays an important role in energy and food security by providing water storage for hydropower generation and food production. Yet, Water, Energy, and Food (WEF) often interplay and evolve dynamically over time with social-economic development and water system expansions. Understanding the WEF Nexus is particularly challenging in transboundary contexts, where interdependencies also develop across multiple riparian countries. In this work, we investigate how to address the WEF Nexus in transboundary river basins to discover innovative solutions mitigating existing tradeoffs and facilitating international agreements. Our approach is demonstrated on the Nile River basin, where we explore tradeoffs between power generation and irrigation water supply across Ethiopia, Sudan, and Egypt. In particular, we analyze innovative portfolios of interventions that combine the coordinated operation of large water reservoirs (i.e., the Grand Ethiopian Renaissance Dam, Merowe Dam, and High Aswan Dam) and the main irrigation diversions, with water demand management options (e.g., aquaponics systems, new desalination plants) for reducing the water demand in the Nile Delta. Our results show that the Nile River basin features both strong tradeoffs and notable synergies across the WEF Nexus and across countries. For example, our analysis shows a clear tradeoff between hydropower generation in Egypt and irrigation water supply in Sudan. In contrast, the hydropower generation in Sudan and Egypt are positively correlated. Additional challenges will be generated by the projected decrease in water availability as suggested by most climate change scenarios. Finally, the potential reduction of the irrigation demands in the Nile Delta can contribute in mitigating existing tradeoffs and represents an additional option in the current international negotiations between Ethiopia, Sudan, and Egypt.