2020 International Conference on the Nile and Grand Ethiopian Renaissance Dam: Science, Conflict Resolution and Cooperation, August 20-21, 2020, Florida International University, Miami, FL USA (Virtual)

Advances in Water Resources Assessment and Optimal Management of Multipurpose Cascade Reservoirs in the Nile River Basin

Getachew Tegegne[1] and Assefa M. Melesse[1]

Abstract

The Nile region needs optimal assessment and management of its water resources considering the ongoing and planned water resources projects in the region. How do we assess and optimally allocate the Nile water resources to each user in the Nile River Basin? This is a philosophical question that can solve the current conflict among the riparian countries of the Nile River Basin. Simulation modeling called what if…? analysis has been a commonly used routine for developing water policies in the Nile region. This approach can evaluate the Nile River Basin water resources system policies developed outside the modeling framework. However, water resources management and development in the Nile region are often capital-intensive and involve multiple users with competing interests. Thus, the Nile region needs an alternative and efficient approach to optimize its system performances by minimizing the system overall cost. Efficient water resources assessment and optimal development of multi-reservoir operation rules considering the proposed and ongoing water resources projects in the Nile region have many relevant purposes. However, despite all the past simulation-based reservoir operation studies in the Nile region, water allocation based on evolutionary and direct policy search algorithms are still missing. And yet, the water resources assessment strategy in the Nile region needs to be updated with more novel approaches relevant to the Nile region. This study proposed a robust approach towards an improved assessment and management of the Nile River Basin water resources. In this study, the reservoir operation rule for the reservoir systems in the headwater catchments of the Nile River Basin has been developed. The study shows how to efficiently assess the water resources potential of the basin as well as presents the strategy on how to reflect reservoir inflow uncertainty in the development of the reservoir operation rule with the evolutionary algorithms. The results, in general, show that the proposed approach improved the overall system performance. Besides, the development of reservoir operation rules considering the ongoing and proposed reservoirs in the region with an evolutionary algorithm will be significant to maximize the water releases to the downstream users by finding a set of efficient solutions along a Pareto-front. Furthermore, this study suggests that the water resources assessment and management approach in the Nile River Basin should be reviewed and updated on a regular basis with significant efforts focused on improving the operational performances of the integrated reservoirs system in the region.

[1] Department of Earth and Environment, Florida International University, Email: gdamtew@fiu.edu

Keywords: Water resources assessment; Water resources management; Reservoir operation, Evolutionary algorithms; Nile River Basin