C207

Impact of Upstream Reservoir System on Downstream Water Level: A Case Study in the Vu Gia - Thu Bon River Basin, Central Vietnam

○Bui Thi Phuong THAO, Sameh A. KANTOUSH, Nguyen Quang BINH, Tetsuya SUMI, Mohamed SABER, Bui Du DUONG, Du Le Thuy TIEN

I. INTRODUCTION

Vietnam faces challenges in managing water resources, particularly floods in the central region. Floods, a global natural disaster, cause annual damage. Vietnam prioritizes urbanization, industrialization, and increased power generation. The government strategically focuses on water resource development for electricity, agriculture, and flood control. Dam construction disrupts river flow, impacting water level fluctuation patterns. Reservoirs play a crucial role in controlling downstream flood risk during the rainy season. However, the collateral effects of hydraulic structures, like dams, require careful consideration. A comprehensive assessment of reservoir operations and their impact on water level fluctuations is crucial. This study aims to evaluate the influence of the Upstream Reservoir System on the Downstream Water Level in the Vu Gia - Thu Bon River Basin (VGTBRB) in Central Vietnam.

II. STUDY AREA

The VGTB River basin, a vital internal drainage system in Vietnam's central region (see Figure 1), spans 10,000 km^2. It includes the Vu Gia (204 km) and Thu Bon (152 km) rivers. The topography ranges from 0 m to 2598 m elevation, with approximately 50% forest cover, followed by agriculture, urban areas, and water bodies. The basin features 18 multipurpose dams for agriculture, hydropower, and water supply, along with 2 water discharge and 16 rainfall stations.The wet season (September to December) poses a flood risk due to substantial rainfall, while the dry season (February to August) experiences minimal rainfall and periodic water shortages.

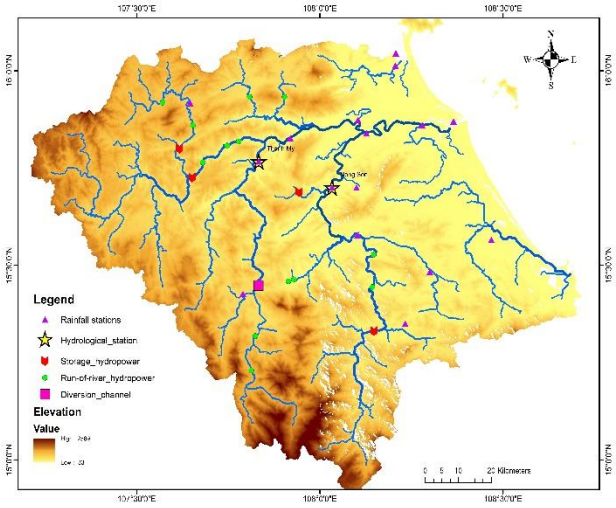


Figure 1: Vu Gia Thu Bon River Basin

III. METHODOLOGY

This study assesses the Hydrological Predictions for the Environment (HYPE) model's performance in simulating reservoir operations. Calibration and validation against observed pre-dam (2000–2009) and post-dam (2016–2020) streamflow and water levels are conducted. Theoretical integration of an Integrated Reservoir Operation System (IROS) (*Du et al (2022)*) is explored, focusing on Qout calculation. Performance indices (NSE, KGE) gauge the model's reliability in replicating observed hydrological patterns, contributing valuable insights into its effectiveness in simulating integrated reservoir operations.

IV. RESULTS

For pre-dam period, the HYPE model was calibrated (2000-2005) and validated (2006-2009) at two hydrological stations, Nong Son and Thanh My, for discharge and water level predictions. Figure 2 (a, b, c, d) and the corresponding evaluation indicators reveal that the HYPE model exhibits satisfactory simulation results at both hydrological stations within the VGTB river basin. During the 2010-2020 period, simulations were conducted to analyze water levels in the VGTB

Figure 2: Model Calibration and Validation

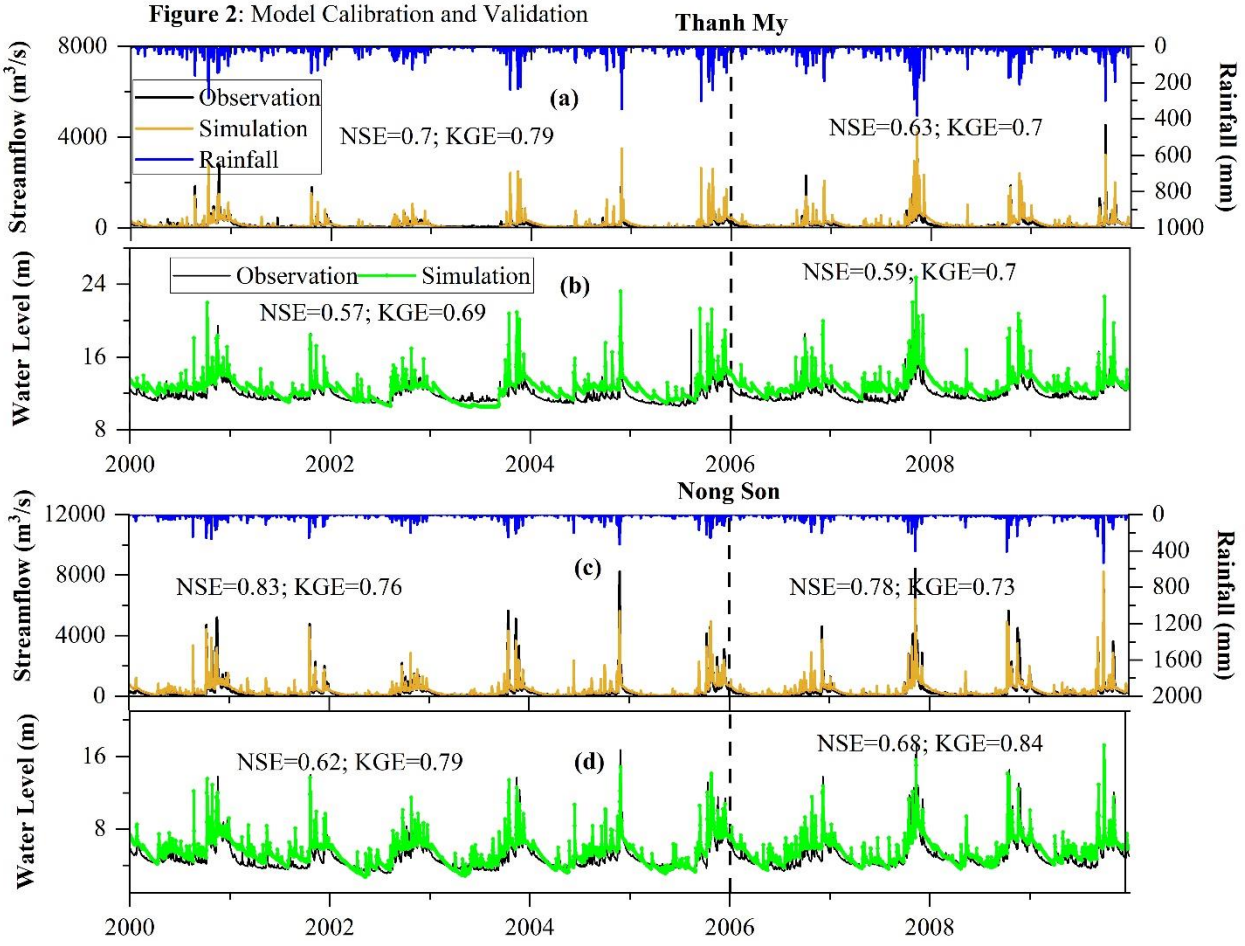
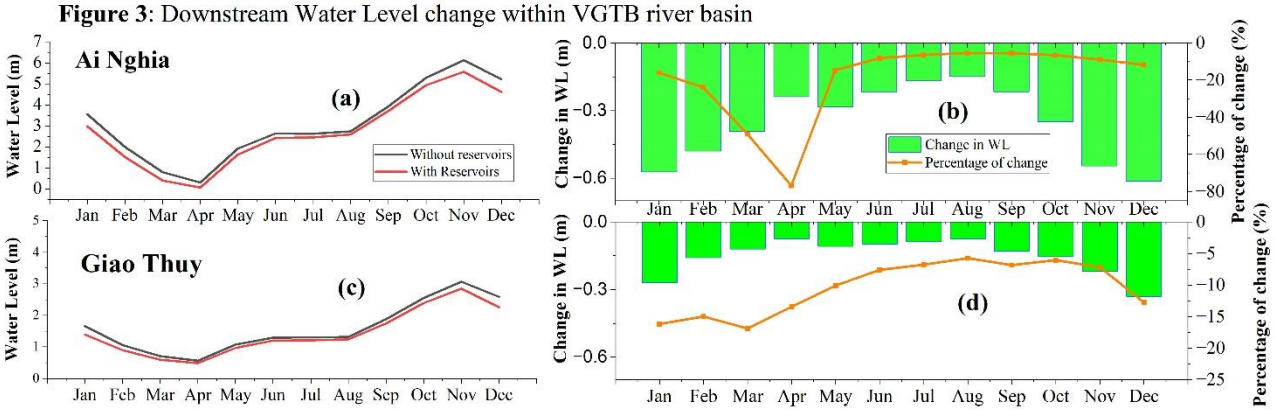


Figure 3: Downstream Water Level change within VGTB river basin



river basin, focusing on the Ai Nghia and Giao Thuy stations with and without reservoirs. The results from Figure 3 show that, throughout the year, the simulated water levels with a reservoir are consistently lower than without at both stations. This indicates the reservoir's effectiveness in mitigating flood risks during the flood season. However, a negative impact is observed during the dry season, emphasizing environmental concerns. In conclusion, while the reservoir proves effective in reducing downstream water levels and preventing floods, further research incorporating hydraulic modeling is needed to understand its specific impacts comprehensively.

REFERENCE: Du, T. L. T. et al (2022). Streamflow Prediction in Highly Regulated, Transboundary Watersheds Using Multi-Basin Modeling and Remote Sensing Imagery. Water Resources Research, 58(3)

ACKNOWLEDGMENT: Supporting of the sponsors with Project: "Integrated Flood and Sediment MAnagement in River basins for susTainable development (FSMART)" funded by Asia-Pacific Network for Global Change Research