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Dynamic decision support systems based on Nash bargaining solution for water resources management in a reservoir-river basin

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Langat River Basin is a strategic catchment in Malaysia, providing water for important demand points including Kuala Lumpur, Klang Valley, Putrajaya, and Cyberjaya. However, the growth of demand, along with recent drought events has warned decision-makers about the reliability and vulnerability of the current water resources system. In this study, two dynamic models based on Nash Bargaining Solution (NBS) were developed to deal with conflict situations. In the first model, a continuous dynamic game model for water allocation in a reservoir system considering the randomness in both reservoir inflow and the rest of the network flow was developed. The second model combined a simulation-optimization modeling method based on coupled System Dynamics (SD) and Game Theory (GT). This model benefits from SD advantages in capturing dynamic behaviors of a system and existing feedback loops between system components during simulation. In order to identify the efficiency of the proposed methods, a case study was carried out at Langat river basin in Malaysia. Based on various reliability indices (Relibility, Resilience and vulnerability) calculated from results obtained, both models are capable of tackling conflict issues in water allocation under situations of water scarcity. The calibrated model was used to simulate for five different managerial scenarios between 2014-2035, and compared against their overall sustainability index (SI) and satisfaction level (SL). The results obtained from analyses showed that supply-oriented policies are temporary solutions, while combining demand and non-revenue water management can secure sustainable development for a more extended period in Langat River Basin.

Keywords: Water shortage, Water Resources Management, Decision support system, System Dynamics, Game Theory, Nash Bargaining Solution