EVALUATION OF TANK MODEL PARAMETERS FOR SPATIAL TRANSFERABILITY WITHIN KALU RIVER BASIN OF SRI LANKA

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Degree of Master of Science

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Supervised by

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DECLARATION

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ABSTRACT

Increasing population, varying climatic condition, and water crisis necessitate water resource planning and development. Incorporating the subwatershed management approach leads to viable options when making decisions on water resources planning and development. Meanwhile, the approach needs streamflow management by incorporating spatial variability of characteristics which requires a hydrologic model and estimation of parameters with gauged data. However, due to non-availability of gauged streamflow at the subwatershed level hinders the estimation of model parameters for each subwatershed. Therefore, it's necessary to identify a suitable lumped model and evaluate the transferability of model parameters for streamflow estimation, which could provide important insights to support the planning and development of watershed management in a distributed manner.

In this study, first, an extensive review was conducted on lumped conceptual hydrologic models to support and facilitate the information for choosing a suitable lumped model for the study. Secondly, the model calibrated and validated using eight years of daily input data from 2009/2010 to 2016/2017, using a semi-automatic calibration method for Ellagawa main and Ratnapura subwatershed of Ellagawa. Hereafter, the calibrated and validated parameters for both watersheds were compared to find out the variation and similarities of parameters. Then, the calibrated parameters for Ellagawa main watershed transferred to Ratnapura and from Ratnapura to Ellagwa watershed, and the applicability of the parameters transfer evaluated in the main and subwatershed for streamflow estimation.

Attribute ranks, of the assessment, revealed that the Tank model with having 4.2 scores got high ranks in the shortlisted 4 models. The model successfully calibrated with the MRAE values of 0.450 for Ellagawa and 0.415 for Ratnapura watershed. The calibrated parameters verified with the MRAE values of 0.452 and 0.361 for Ellagawa and Ratnapura watershed respectively. When the calibrated parameters for Ellagawa transferred to Ratnapura and from Ratnapura to Ellagawa for the data period from 2009/2010 to 2016/2017 which was same for both watersheds, the transferred parameters to Ratnapura simulated the overall streamflow of the watershed with significant MRAE value of 0.445, while transferred parameters of Ratnapura to Ellagawa, showed a decline in the model performance with the MRAE value of 0.551.

Findings of the study revealed that the Tank model is the right lumped conceptual model for the transferability of parameters across the scale in a watershed. In the first case of parameter transfer of the model from main to subwatershed the transferred parameters estimated the subwatershed response with a high level of accuracy. Similarly, the calibrated parameters of the subwatershed estimated the behavior of the main watershed satisfactorily, while, compared to the first case the model showed a significant decline in the performance. This indicates the applicability of a calibrated lumped model of the main or subwatershed to other ungauged sub or main watershed for streamflow estimation to achieve the objective of subwatershed management and accurately make the decisions on water resources planning and management.

Keywords: Subwatershed Management, Parameter Transferability, Lumped Modeling

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