APPLICABILITY OF MODEL PARAMETER TRANSFERABILITY OF TANK MODEL IN STREAMFLOW SIMULATION IN GIN RIVER BASIN

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Thesis submitted in partial fulfillment of the requirements for the degree Master of Engineering in Water Resources Engineering and Management

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in text.

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B. P. D. Boralugoda Date

The above candidate has carried out research for the Master's thesis under my supervision.

……. …….

Professor N.T.S. Wijesekera Date

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ABSTRACT

Amidst of the population growth and increased demand due to rising level of living standard, stress on the water resources has been increased rapidly in recent years. Water practitioners, researchers have been stressing on the need of development of water resources in integrated and cohesive manner. Hydrological modelling has become the essential tool for planning and designing of water resources development as it gives the quantity of water available. Many modelers face the problem of developing solutions at ungauged basins. Typically, hydrological models are developed at gauged locations and whenever necessary, modelers tend to use the same model structure with verified parameters. This is a gray area in hydrological society as the model transferability is yet to be convinced. The need of more researches is essential in this regard for increase confidence of use of model parameter transferability.

This study developed a lumped conceptual tank model with four tanks for simulating streamflow in Gin Ganga basin at Tawalama and Baddegama and appraise the effectiveness of the model parameter transferability in ungauged basins of Gin basin. Model is developed in MS Excel and multi-start GRG-nonlinear search engine is used as parameter optimizing method while employing Mean Ratio of Absolute Error (MRAE) as the objective function to evaluate goodness of fit of the optimized parameters. Daily precipitation and evaporation data from water years 2008/09 to 2017/18 is used for the modeling. Model was warmed up using five water years to stabilize soil moisture in each calibration and validation. Calibration for each catchment was done using first five years of data and validation was done using remaining portion of data. Thereafter, optimized parameters were transferred under spatiotemporal, spatial and temporal approaches to simulate the flow of each catchment. Then model performance was evaluated in each scenario by comparing goodness of fit, annual water balances, flow hydrographs and flow duration curves for low, high, and medium.

The models were calibrated at Baddegama and Tawalama with MRAE value of 0.233 and 0.246 respectively for daily streamflow simulation. Then both models were validated for the two location with MRAE of 0.298 and 0.346 respectively. Better matching in high and medium flow is observed while average annual water balance error varying from 1.7% to 19% on average. All three transferability methods showed adequate results while maintaining accuracy ranges from 59% to 72% in daily streamflow simulation and model predicted average annual and average monthly flow estimations with an accuracy of 81% and 77% respectively under any transferability approach. Among the three approaches spatial transferability is selected as the best since it shows streamflow simulation accuracy over 66% and annual water balance errors varying with 1.7% to 3.4% on average. Further, spatiotemporal transfer method shows accuracy over 56% and temporal transfer has showed accuracy over 69% in daily streamflow simulation. In all modelling effort it was observed that accuracy of monthly flow estimations was over 77% and accuracy of annual water balance was over 81% on average.

Finally, the model could be used to predict daily streamflow with an accuracy of 68% and monthly scale flow estimations with an accuracy of 89% by applying either set of optimized parameters, indicating the model suitability for parameter transferability & water management in ungauged catchments in Gin Ganga basin.

Key Words: Conceptual Lumped Tank model, Parameter regionalization, Hydrological modelling, ungauged catchment, water resources management, Daily data

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