PRECIPITATION TRENDS OVER THE THREE CLIMATIC ZONES OF MAHAWELI BASIN AND EVALUATION OF CLIMATE CHANGE IMPACTS ON STREAMFLOW VARIABILITY

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

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Dr. R.L.H.L. Rajapakse Date

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Precipitation Trends over the Three Climatic Zones of Mahaweli Basin and Evaluation of Climate Change Impacts on Streamflow Variability

ABSTRACT

Climate change is expected to inflict severe consequences on the hydrological cycle and water resources of a catchment. With this backdrop, it is crucial to have better insight into the functioning of current water resources systems along with future water resources planning and management due to the fact that amidst growing populations and ever-increasing resource use, competition among users, and more recently, widespread ecosystem degradation and climate change impacts have exacerbated the already grave situation. In order to assess this impact, a semi-distributed monthly water balance model was adopted and developed to simulate and predict the hydrological processes incorporating several predicted future climatic scenarios.

This study focuses on analyzing the long-term precipitation trends in the three distinct climatic zones and climate change impacts on streamflow variability in Mahaweli basin which extends over wet, dry and intermediate climatological zones. Monthly precipitation data for a span of 30 years from 1988-2018 have been used for trend analysis using Mann-Kendall and 15-year monthly rainfall and streamflow data set is used for calibration and validation of "*abcd*" hydrological model to evaluate the climate change impacts on streamflow for future water resources management at three selected sub-watersheds in each zone of the basin. The changes in precipitation and temperature during the study period were correlated differently with observed changes in streamflow. The rainfall trends in the intermediate and dry zone parts of the basin were identified to be positive while the trend in the wet zone part was found to be decreasing, however, not statistically significant in both cases. Streamflow precipitation elasticity was evaluated for sensitivity check.

The "abcd" hydrologic model can be recommended to use for streamflow simulations and water resources investigations in monthly temporal resolution for the watersheds which are having similar characteristics with parameter values in the ranges of *a* (0.961-0.998), *b* (0-250), *c* (0.001-0.999) and *d* (0.01-0.999). The *abcd* model has proven to be a valuable tool not only for assessing the hydrologic characteristics of diverse watersheds but also for evaluating the hydrologic consequences of climate change in selected basins which may also be helpful in both pre-disaster risk management and post-disaster rehabilitation.

Keywords: Lumped model, Mann-Kendall, Streamflow elasticity

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LIST OF ABBREVIATIONS

Abbreviation	Description
IPCC	Intergovernmental Panel on Climate Change
MSL	Mean Sea Level
Pt	Monthly precipitation
Et	Actual evapotranspiration,
Rt	Recharge to groundwater storage,
QU_t	Upper zone contribution to runoff
XU_t	Upper soil zone soil moisture storage at the current time step
XU_{t-1}	Upper soil zone soil moisture storage at the previous time step
MRAE	Mean Ratio of Absolute Error
MSE	Mean Square Error
NSE	Nash Sutcliffe efficiency
SC	Field capacity of the catchment
WMO	World Meteorological Organization
EOt	Evapotranspiration opportunity
Rt	Groundwater Recharge
XL_t	Soil moisture storage in ground water compartment after recharging
QL_t	Discharge from ground water compartment
Q_t	Total stream flow
PE	Potential Evapotranspiration
FAO	Food and Agriculture Organization
Kc	Crop coefficient
Cp	Pan Co-efficient
Rem	Relative Maximum Error
RMSE	Root Mean Square Error