ASSESSMENT OF CLIMATE CHANGE IMPACT ON WATER AVAILABILITY IN UPPER MAHAWELI RIVER BASIN, SRI LANKA

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Degree of Master of Science

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South Asia Water Management (UMCSAWM)

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ABSTRACT

Assessment of Climate Change Impact on Water Availability in Upper Mahaweli River Basin, Sri Lanka

Climate change, population increase, and economic development will all have an impact on future water availability for drinking water supply, agriculture, and recreation activities, with different effects in different regions. The present study investigates the potential impact of climate change on future water availability in the Peradeniya sub-catchment of the Upper Mahaweli river basin. The hydrological modeling of this study was performed by Hydrologic Engineering Centre Hydrological Modelling systems (HEC-HMS). In this study, the entire catchment area was divided into three sub-basins to simulate runoff at the outlet of the catchment and the model results were calibrated and validated using historical streamflow data. Future runoff based on calibrated parameters was estimated after bias correction of climate rainfall data for representative concentration pathways (RCP) 4.5 and RCP 8.5 scenarios. Further, an assessment of water availability based on annual and seasonal periods was carried out from the model results.

The model calibration carried out from 1990 to 1994, indicated good model results in terms of objective functions where root mean square error (RMSE) is 0.60, Nash-Sutcliffe (NSE) is 0.62, and Percent Bias is -15%. Further, validation of model results from 1994 to 2000 yielded RMSE of 0.60, NSE of 0.52, and Percent Bias of 13.9 % indicating good model results. From the results obtained, it was identified that the water availability will increase for both scenarios RCP 4.5 and RCP 8.5 during the mid-century (2040-2060) and end-century (2080-2100) period. The annual water availability concerning the historical period will increase by 27.34 % during the mid-century period and will further increase by 42.06 % during the end-century period in the RCP 8.5 scenario. The seasonal water availability in mid-century compared to the historical period will be more affected during the first inter-monsoon (FIM) period with an average increase of 69 % and 83 % in RCP 4.5 and RCP 8.5 scenario, respectively. Whilst the seasonal water availability will decrease during the first inter-monsoon (FIM) in the end-century compared to the mid-century period by 26 % and 27 % in RCP 4.5 and RCP 8.5 scenarios, respectively. The findings of this study can be useful for the water managers and stakeholders to manage future water needs in the basin and reduce the future vulnerabilities associated with the increasing water availability in the basin.

Keywords: Climate Change, Precipitation-Runoff Process, HEC-HMS

DEDICATION

I dedicate this thesis to my Father and Mother for their dedicated partnership for success in my life.

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LIST OF ABBREVIATIONS

CMIP	Coupled Model Intercomparison Project
CORDEX	Coordinated Regional Climate Downscaling Experiment
DMC	Disaster Management Center
EP	Effective Precipitation
ERA	ECMWF Re-Analysis
GCM	General Circulation Model
GHG	Greenhouse Gas
HEC-HMS	Hydrologic Engineering Centre - Hydrologic Modeling System
IAM	Integrated Assessment Models
IDW	Inverse Distance Weightage Method
IPCC	Inter-governmental Panel for Climate Change
NSE	Nash Sutcliff Efficiency
PET	Potential Evapotranspiration
RCM	Regional Climate Model
RCP	Representative Concentration Pathways
RMSE	Root Mean Square Error
UNFAO	Food and Agriculture Organization of the United Nations
WAI	Water Availability Index
WMO	World Meteorological Organization