RAINFALL-RUNOFF SIMULATION MODEL BASED ON WATER BALANCE CONCEPT FOR BASINWIDE WATER RESOURCE ASSESSMENT - A CASE STUDY IN UPPER AND LOWER CATCHMENTS OF DEDURU OYA BASIN, SRI LANKA

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Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Water Resources Engineering and Management

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October 2015

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 expect where the acknowledgment is made in text.

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

ABSTRACT

A rainfall-runoff simulation model based on water balance concept was developed and applied for the water resources assessment in upper and lower catchments of Deduru Oya basin. The model was selected due to its capacity to analyze the spatial variation of runoff generation characteristics, simplicity and limited input data requirement. The model was developed for the entire basin where the model parameters were calibrated, validated and optimized appropriately using monthly hydrological datasets. The calibration run results obtained were found to be acceptable with value of 0.17 for Mean Ratio of Absolute Error (MRAE) and 0.91 for Nash–Sutcliffe Coefficient (NSC) which were used as error estimates. At the same time, the basin was divided into two sub-catchments and modeled separately using refined constant parameter values which have been used for entire basin to check the performance of the model. In this case, incorporation of sub-catchments separately has shown better performance of the model enhancing model accuracy by 2% according to MRAE and same value for NSC. The river gauging station in the downstream of the reservoir is not functioning since the commissioning of the reservoir in 2014. To overcome the issues in decision making due to the lack of continuous observed streamflow data up to date and to study reservoir effect on stream flow, the calibrated and validated model was extended by carrying out a model scenario analysis with the incorporation of the recently commissioned Deduru Oya Reservoir and associated basin conditions as of August, 2015 in an attempt to perform a basin wide water assessment with the objective to overcome the data inadequacies pertaining to required spatial and temporal resolutions in historical precipitation and streamflow time series data. The construction of the reservoir was found to have a significant impact in reducing peak floods in the downstream due to mid-level extreme events by dampening and reducing the peak flood. It was found that due to a similar event in May 2015, the reservoir retention and detention was effective in reducing the associated peak flood by 66.04%. However, the impact on extreme events were found to be reduced due to possible opening of the gates. The results of the extended model were not validated due to unavailability of observed data. However, these results will provide reference and scope for the future research in the same field. The study concluded that the rainfall-runoff modelling is an essential tool for comprehensive assessment and management of water resources and the model can be applied in the same basin with future conditions or in basins with similar characteristics elsewhere.

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