ESTIMATION OF SCS CURVE NUMBER FOR STREAMFLOW MODELLING - A CASE STUDY OF BADALGAMA WATERSHED IN MAHA OYA BASIN, SRI LANKA

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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 acknowledgement is made in the text.

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ABSTRACT

Estimation of SCS Curve Number for Streamflow Modelling - A case study of Badalgama Watershed in Maha Oya Basin, Sri Lanka

Accurate runoff estimation is a prerequisite for effective management and development of water resources. Many methods are being used to estimate runoff in literature. However, the SCS-CN method still remains a popular, fruitful and frequently used method in Sri Lanka and elsewhere around the world. The attractive feature of the SCS-CN method is that it integrates the complexity of runoff generation into a single parameter, i.e. curve number (CN). In Sri Lanka, the CN is usually selected from available standard tables in the National Engineering Handbook, Section-4 (NEH-4). However, such an estimation could yield erroneous results in the absence of a research on different CN estimation methods. The present study carried out an event based runoff estimation in Badalgama watershed of the Maha Oya basin using CN values from two different CN determination methods; i) weighted CN value using NEH-4 and, ii) rainfall-runoff data. The SCS unit hydrograph was developed to make the study more usable for other ungauged watersheds with similar characteristics. Concave method was used for baseflow separation and the constant loss method was incorporated for the determination of effective rainfall. Twenty events each for calibration and verification were used which formed a representative data from both perspective of quantity of flows and the seasons.

Model evaluation was carried out by first developing CN_{II} for both the cases. Then, since the event separation was required rendering rainless period before the start of the event, CN_I values were also computed and evaluated. Finally, the selected CN was manually optimized for individual calibration events and the average was used for model verification. Parameter optimizations were done with the Mean Ratio of Absolute Error (MRAE) as the objective function while the Ratio of Absolute Error to Mean (RAEM), Ratio of Absolute Errors (RAE) corresponding to Q_p, T_p, T_b of the hydrographs were computed to reflect the goodness of fit. Based on the modelling results, it could be identified that 3 out of 4 SCS-CN models developed for the Badalgama watershed were not representative of the watershed response reflected in the observed hydrographs. The average MRAE and RAEM among the four methods was between 0.36 ~ 2.18 and 0.54 ~ 2.08, respectively.

The present work revealed that the use of CN_I values from weighted CN method was the nearest to model reality followed by the CN_{II} determination from rainfall runoff model. Use of CN_I from rainfall-runoff data yields the most inaccurate result followed by the CN_{II} from the weighted CN method. The SCS-CN model developed using individual parameter optimized CN value for the Badalgama watershed produced average MRAE of 0.22 and average RAEM of 0.30 in calibration and an average of 0.37 and 0.49 in verification, respectively. The average RAE value corresponding to Q_p, T_p, T_b and streamflow volume were 0.78, 0.37, 0.43 and 0.42, respectively, in model verification. The SCS-CN method is the best reasonably suitable method for quick and fairly accurate runoff estimation in the regions such as the wet zone of Sri Lanka where hydrologic gauging stations are not widely available.

Keywords: runoff generation, event based modelling, baseflow separation, wet zone

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