ASSESSMENT OF TRADITIONAL WATER YIELD FORECASTING METHODS BASED ON SELECTED TWO DRY ZONE BASINS IN SRI LANKA

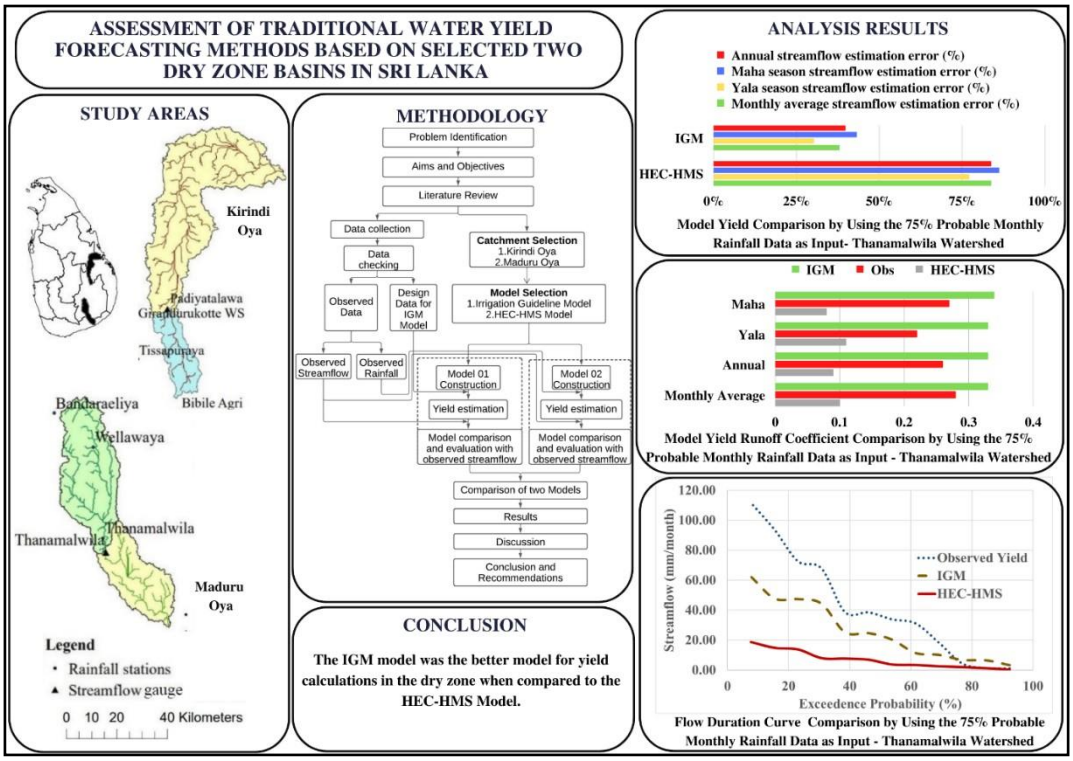
W.D.P. Madusanka [1, *], R.L.H.L. Rajapakse [1]

[1] Department of Civil Engineering, University of Moratuwa, Moratuwa

The majority of dry zone basins are still ungauged in Sri Lanka, and this has led to uncertainties in the planning and development of water management infrastructure. The Irrigation Guideline of Sri Lanka (IGM) has been widely in use to estimate the basin yield, but even so, there is insufficient evidence to evaluate the accuracy of the estimations under the changing climate conditions. Therefore a need exists for the comparison of available water yield models to close this gap and provide accurate yield estimations. In the current study, the observed streamflow yield data from Kirindi Oya and Maduru Oya basins were used to compare the yield estimates derived from the IGM and HEC-HMS models. Daily and 75% probable rainfall data were considered as the input data for the models and the model results were compared with the observed streamflow data. The evaluation has been carried out by considering the flow hydrographs, annual cumulative error, flow duration curves, runoff coefficients, and the Mean Ratio of Absolute Error (MRAE) value as an indicator. The two dry zone basins Thanamalwila and Padiyathalawa were considered for the study. The periods of comparison of the Thanamalwila and Padiyathalawa watersheds were from 2000-2015 and 2007-2015, respectively. Cumulative water yield error between observed and simulated yield, flow duration curves, and runoff coefficients were the critical elements used to compare simulation results with observations. Comparisons in the two selected basins show that the IGM is still the better model for estimating yield in watersheds in the dry zone, and it was found that rainfall is the dominant factor influencing yield. The comparison of the two models by using the 75% probable rainfall data as indicated in the IGM (Analysis 1) as the input data showed that it is the closest monthly yield evaluation model compared to observed data in the Padiyathalawa and Thanamalwila watersheds and annual differences in estimations were 47.9% and 39.8%, respectively. The HEC-HMS model results ended up with 83.9% and 83.8% annual differences for Padiyathalawa and Thanamalwila watersheds, respectively. In the comparison of the two models by using the actual rainfall data collected from the selected gauging stations (Analysis 2), for the Padiyathalawa watershed, HEC-HMS gives the closest monthly yield estimation with a 34.18% annual streamflow overestimation error. For the Thanamalwila watershed, the IGM model gives the closest monthly yield estimation, and the annual error was 32.2%. The HEC-HMS model gives overestimated values in the Padiyathalawa watershed in Analysis 2 while producing underestimated values in other cases. The IGM produces underestimated values for all cases. Due to the ambiguous variation of HEC-HMS yield results in each watershed in the same zone, it is recommended that the IGM model be used for yield estimations in the dry zone basins with similar characteristics.

Keywords: HEC-HMS, Irrigation guideline of Sri Lanka, Kirindi Oya and Maduru Oya, Sensitivity analysis, Watershed yield

*Correspondence: dpasindu96@gmail.com


ASSESSMENT OF TRADITIONAL WATER YIELD FORECASTING METHODS BASED ON SELECTED TWO DRY ZONE BASINS IN SRI LANKA
STUDY AREAS
Kirindi Oya
Padiyatalawa
Girandurukotte WS
Tissapuraya
Bibile Agri
Bandaraeliya
Wellawaya
Thanamalwila
Thanamalwila
Maduru Oya
Legend
Rainfall stations
Streamflow gauge
0 10 20 40 Kilometers
METHODOLOGY
Problem Identification
Aims and Objectives
Literature Review
Data collection
Data checking
Catchment Selection
1.Kirindi Oya
2.Maduru Oya
Observed Data
Design Data for IGM Model
Model Selection
1.Irrigation Guideline Model
2.HEC-HMS Model
Observed Streamflow
Observed Rainfall
Model 01 Construction
Model 02 Construction
Yield estimation
Yield estimation
Model comparison and evaluation with observed streamflow
Model comparison and evaluation with observed streamflow
Comparison of two Models
Results
Discussion
Conclusion and Recommendations
CONCLUSION
The IGM model was the better model for yield calculations in the dry zone when compared to the HEC-HMS Model.
ANALYSIS RESULTS
Annual streamflow estimation error (%)
Maha season streamflow estimation error (%)
Yala season streamflow estimation error (%)
Monthly average streamflow estimation error (%)
IGM
HEC-HMS
0% 25% 50% 75% 100%
Model Yield Comparison by Using the 75% Probable Monthly Rainfall Data as Input- Thanamalwila Watershed
IGM Obs HEC-HMS
Maha
Yala
Annual
Monthly Average
0 0.1 0.2 0.3 0.4
Model Yield Runoff Coefficient Comparison by Using the 75% Probable Monthly Rainfall Data as Input - Thanamalwila Watershed
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Streamflow (mm/month)
Observed Yield
IGM
HEC-HMS
0 20 40 60 80 100
Exceedence Probability (%)
Flow Duration Curve Comparison by Using the 75% Probable Monthly Rainfall Data as Input - Thanamalwila Watershed