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Prediction and comparison of ungauged catchments from urbanized Pinga Oya and forested Mahaweli River basins in Sri Lanka

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A hydrologic study was carried out aiming at prediction and comparison of ungauged basins from two different environments in Sri Lanka. Three ungauged sub-catchments in an urbanized Pinga Oya Basin (POB) (between 7° 19' to 7° 26' N and 80° 36' to 80° 38' E), and six ungauged sub-catchments in the Mahaweli River Basin (MRB) (between 7° 06' to 7° 20' N and 80° 49' to 80° 59' E) in Sri Lanka were modeled using synthetic unit hydrograph (SUH) methods described in the Flood Studies Report (FSR) of National Environmental Research Council (NERC), UK (1975). POB falls in the wet zone (> 2500 mm annual rainfall) while MRB falls into the intermediate zone (1250 - 2500 mm annual rainfall). Required parameters were calculated based on the guidelines given in the FSR with the support of local maps, ArcGIS, SPSS and OriginPro software. The study provided SUH, 200-year flood peak predictions and regional coefficients for each sub-catchment. The peak discharges for POB derived from SUH fall within 2 to 4 hours from the onset of a precipitation event, while for the selected MRB they fall within 1.9 to 3 hours. The URBAN factor derived based on the population density with respect to POB equals 0.2. A positive exponential relationship ($R^2 = 0.99$) was observed with the URBAN factor and the peak discharges. However, for MRB it equals 0. The 200-year flood peaks range from 53.7 to 85.5 m^3/s for POB whereas it ranges from 57.2 to 292.5 m^3/s for MRB. Pinga Oya sub-catchment has a peak discharge of 76.6 m^3/s for a 200-year return period, which in return causes flooding in Akurana area. A comparison of results with those obtained for the forested MRB was also completed. Although a higher peak and a shorter lag are expected in the POB and a longer lag and a smaller peak discharge are expected for MRB, the comparison resulted in an inversion. This could be explained by the shape and the slope of the basins. The selected sub-catchments in the MRB have elongated shapes with narrow headwater regions, whereas Pinga Oya and Hunnan Oya sub-catchments have wide headwater regions having triangular shapes. On the other hand, the selected MRB are relatively steeper than POB, with MRB having S1085 values ranging from 25.8 to 80.9 m/km and POB having S1085 ranging from 5.9 to 18.9 m/km. Such shape and slope parameters allow faster runoff than infiltration that spontaneously provides a higher peak and a shorter lag in the MRB. The comparisons provide assessments based on geomorphic and environmental control over discharge through catchments. Therefore, these outputs could be effectively utilised for the future environmental management of ungauged drainage basins.