

Assessing Evapotranspiration and Environmental Factors in the Upper Montane Forest at Horton Plains and The Eucalyptus Plantation Forest on its Eastern Slope

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The Horton Plains National Park (HNP) and its upper montane forest (UMF) play critical roles in Sri Lankan agriculture as the origin of three major rivers. Evapotranspiration is a major component of the water balance of this ecosystem. Our objectives were to, (a) compute the reference evapotranspiration (ET_o) of UMF-HNP, defined as the evapotranspiration of a vegetation surface not experiencing water deficits, (b) determine its controlling factors and (c) compare it with ET_o of the Eucalyptus plantation forest (EuF) on the eastern slope of HNP. Automated weather stations were established at HNP and in EuF at Ohiya to record climatic data at one-minute intervals. The FAO Penman-Monteith equation was used to compute per-minute ET_o . Leaf area index (LAI) of UMF-HNP (2.089 ± 0.054) was measured using hemispherical photography. LAI of EuF was computed as the median (2.61) of 46 published values. Canopy surface resistance was computed as the ratio between leaf stomatal resistance (r_l) and $0.5 \times LAI$. Median of 41 published values of r_l (138.89 s m^{-1}) was used for EuF whereas a standard value of 100 s m^{-1} was used for UMF-HNP. Aerodynamic resistance was computed as a function of canopy height, surface roughness and wind speed. Per-minute calculations of day-time ET_o were summed to daily ET_o . Over the 69-day period of calculation, UMF-HNP had greater cumulative ET_o (123.39 mm) and daily mean ET_o ($1.788 \pm 0.081 \text{ mm d}^{-1}$) than EuF (55.39 mm and $0.803 \pm 0.056 \text{ mm d}^{-1}$). In both ecosystems, daily ET_o showed highly-significant ($p < 0.0001$) positive linear relationships with daily total solar irradiance (S_R), air temperature (T_a) and vapour pressure deficit (VPD) while showing significant ($p < 0.01$) second-order polynomial relationships with daily mean wind speed (W_s). Paired t-tests showed significantly ($p < 0.0001$) greater daily ET_o , S_R and W_s and lower T_a in UMF-HNP than in EuF. The higher ET_o was primarily caused by the higher S_R .

Keywords: FAO Penman-Monteith equation, Evapotranspiration, Climatic variables, Solar irradiance, Canopy surface resistance, Aerodynamic resistance

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