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Pan coefficient for irrigation scheduling across the Palghat Gap of Kerala

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ABSTRACT

Pan coefficients were computed to derive reference evapotranspiration needed for irrigation scheduling in Kerala region of India. The monthly pan coefficients derived from the simple linear equation vary between 0.8121 and 1.1054. The pan evaporation multiplied by monthly/seasonal pan coefficient can be used for scheduling irrigation to plantation crops.

Key words: Reference evapotranspiration, Pan evaporation, Pan coefficient.

Perennial crops like arecanut, cardamom, cocoa, coffee, coconut, rubber and tea grown in Kerala State require summer irrigation for obtaining better yield. This is also true in case of banana and seasonal crops that are grown during *Mundakan* and *Punja*, which coincide with winter and summer, respectively. Irrigation is practiced during the above two seasons through surface, drip and sprinkler methods and its frequency is decided based on IW/CPE ratio in case of plantation crops. The CPE (Cumulative Pan Evaporation) could be replaced with reference evapotranspiration. However, pan evaporation is considered in irrigation scheduling due to its easy access. Moreover, computation of reference evapotranspiration need data on several weather variables which are recorded and maintained at a few locations only. Similar is the case with several universally accepted formulae for computing potential evapotranspiration. Though lysimetric method is better for computing evapotranspiration when compared to empirical formulae under field conditions, it is very expensive and immobile in addition to being location and crop specific. Keeping the above in view, an attempt has been made to compare between reference evapotranspiration and open pan evaporation and derived a relationship between them in tropical monsoon climates, which may be more appropriate from operational point of view.

MATERIALS AND METHODS

The monthly meteorological variables viz., maximum and minimum temperatures, wind speed, relative humidity, pan evaporation and sunshine were collected from the weather records maintained at the Department of Agricultural Meteorology,

Table 1: Monthly and seasonal pan coefficients across the Palghat Gap of Kerala

Month	Pan coefficient (b)	Pan evaporation (X)	Reference evapotranspiration during 2001		
			Estimated (Y=bX)	Actual	% Deviation
January	0.8121	6.43	5.22	5.25	-0.57
February	0.8363	5.07	4.24	4.66	-9.01
March	0.8444	5.52	4.66	5.05	-7.72
April	0.8910	4.27	3.80	4.50	-15.56
May	0.9260	3.93	3.64	4.17	-12.71
June	1.0136	2.93	2.97	2.64	12.50
July	1.0174	2.69	2.74	2.83	-3.18
August	0.9988	3.12	3.12	3.08	1.30
September	1.0809	4.13	4.46	3.77	18.30
October	1.1054	3.42	3.78	3.40	11.18
November	1.0100	4.07	4.11	3.85	6.75
December	0.8303	5.86	4.87	4.92	-1.02

Season	June-September	October-November	December-February	March-May
Pan coefficient	1.0318	1.0579	0.8275	0.8890

College of Horticulture, Vellanikkara from 1984 to 2000. The reference evapotranspiration was worked out using the CROPWAT software developed by Smith (1992). Pan coefficients were worked out month-wise as well as season-wise using the equation Y= bX, where Y is reference evapotranspiration and X is open pan evaporation and 'b' is constant. A simple linear regression equation was also worked out between actual and estimated reference evapotranspiration and also tested for the year 2001.

RESULTS AND DISCUSSION

The mean monthly reference evapotranspiration versus pan evaporation from 1984 to 2000 indicated that they are relatively in agreement between May and November. The difference between them was minimal from June to August while maximum from December to February (Fig.1). The season-wise difference between the two is the maximum (1.04 mm per day) during winter (December - February), followed by summer (March-May: 0.60 mm per day) while minimum

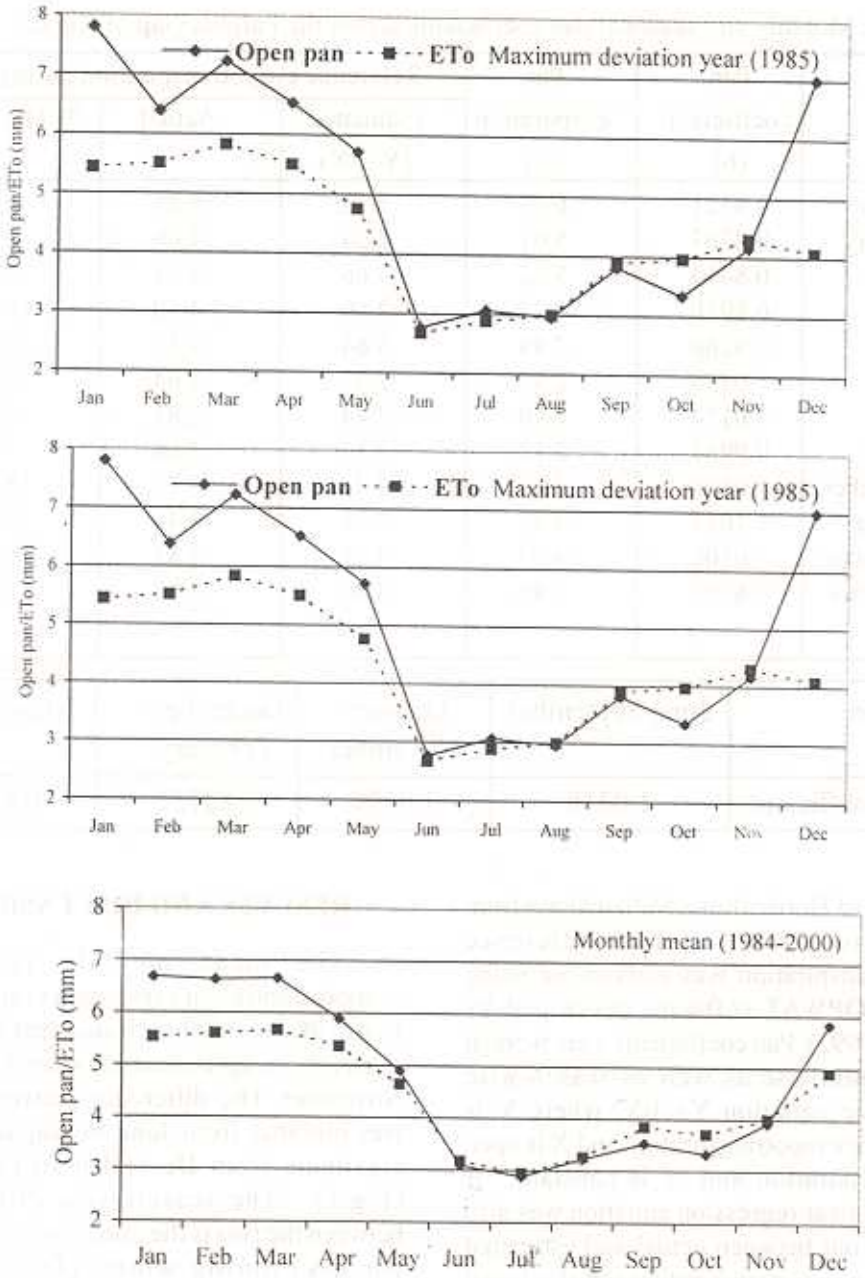

Fig. 1: Monthly reference evapotranspiration versus open pan evaporation at Vellanikkara, Thrissur, Kerala

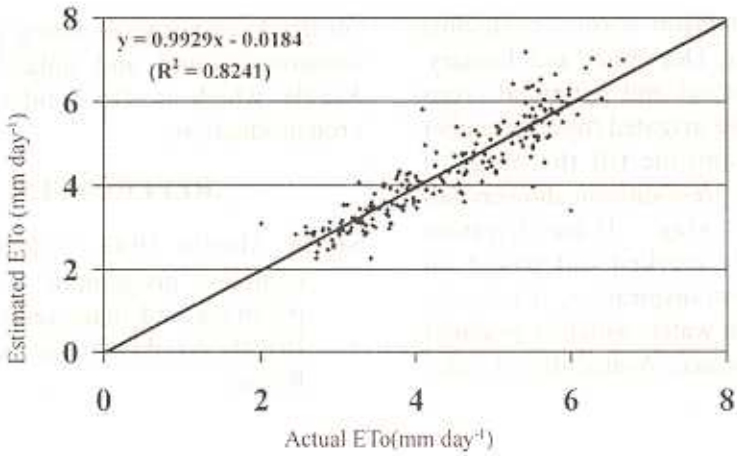

Fig. 2: Actual versus estimated reference evapotranspiration

(0.13 mm per day) during southwest monsoon (June-September), followed by post monsoon (October - November: 0.24 mm per day). The same trend is noticed in all the years. However, the difference between reference evapotranspiration and pan evaporation was high in 1985 and low in 1995. This was attributable due to high wind speed that prevailed across the Palghat Gap from December to May, 1985 when compared to that of 1995. The average daily wind speed varied between 5.6 and 12.6 km h^{-1} in 1985 as against 3.7 and 9.0 km h^{-1} in 1995. It revealed that the reference evapotranspiration was less than the open pan evaporation from December to April while it matches relatively well in remaining months (May-November).

The monthly pan coefficients derived from linear equation vary between 0.8121 and 1.1054 (Table 1). The season-wise pan coefficients derived are 1.0318, 1.0579, 0.8275 and 0.8890. The monthly actual and estimated reference evapotranspiration over a period of 17 years (1984-2000) gave a fairly significant (R^2 =0.82) linear distribution between them (Fig. 2). The estimated reference evapotranspiration using the pan coefficients for the year 2001 was also in good agreement with the actuals (Table 1), indicating that the pan coefficients could be used for estimating reference evapotranspiration in the months when the deviation is less than 10% from November to March during which only irrigation is practiced. Hence, the monthly reference evapotranspiration (Y) could be worked out using pan evaporation (X) multiplying with derived monthly pan coefficient. This could be used for irrigation scheduling in plantation and seasonal crops across the Palghat Gap of Kerala. However, the reference evapotranspiration needs to be validated where the wind speed is high as the gap between the two methods is wide during winter. Across Thrissur and Palaghat districts of Kerala, wind speed is very high

during the *Mundakan* season, coinciding with November, December and January. Normally, seasonal and perennial crops across Kerala are irrigated from December to May and continue till the onset of monsoon if the pre-monsoon showers fail during March - May. If the irrigation requirement is worked out based on reference evapotranspiration, it helps in saving irrigation water, which is essential where water is scarce. Availability of water for irrigation purposes during summer is a constraint in mid- and- upland regions of Kerala, which mostly decides plantation crop production.

REFERENCES

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