

Research Note

ESTIMATION OF POTENTIAL EVAPOTRANSPIRATION WITH HARGREAVES-SAMANI MODEL AT VARIOUS LOCATIONS IN PUERTO RICO¹

The objective of this study was to estimate potential evapotranspiration (PET) with the Hargreaves-Samani model (equation 1/)² and estimated temperature data.³

$$PET = 0.0023 \times Ra \times (T + 17.8) \times (T_{max} - T_{min})^{0.6} / 1/$$

where PET = potential evapotranspiration in mm/day, Ra = extraterrestrial radiation in mm/day, Tmax = mean maximum temperature in °C, Tmin = mean minimum temperature in °C, T = mean average temperature in °C. For Puerto Rico, Ra (mm/day) was 11.68 for January, 13.02 for February, 14.65 for March, 15.83 for April, 16.30 for May, 16.38 for June, 16.38 for July, 15.80 for August, 15.23 for September, 13.62 for October, 12.11 for November, 11.29 for December.² Locations were Aceituna, Adjuntas, Barceloneta, Bayamón, Hato Tejas, Cabo Rojo, Calero Camp, Caonillas Villalba, Carite I, Cataño, Central San Francisco, Coamo Dam, Ensenada, Guajataca Dam, Guayabal reservoir, Guayanilla, Gurabo, Indiera Baja, Jájome Alto, La Fe, Maricao, Maricao Fish Hatchery, Martrullas Dam, Maunabo 1 SW, Mora Camp, Naguabo 6 W, Parafso, Peñuelas Salto

Garza, Puerto Real, Río Blanco Lower, Río Blanco Upper, San Lorenzo, Espino, San Sebastián, Santa Isabel 3 NW, Santa Rita, Toa Baja, Constancia, Toro Negro Plant 2, Villalba, Yabucoa 1 NNE, Yauco 1 S. Latitude, longitude and altitude above sea level for these locations are given by Ravaló et al.⁴ In the absence of actual temperature data, estimated maximum, minimum and average temperature were used.³ Results are indicated in table 1.

In all cases the maximum PET occurs in July and the minimum PET in December. The PET range (mm/month) was 87.9 to 174.2 among these locations. These PET values can be used to plan irrigation and water management projects. Estimating crop water requirements on the basis of PET in combination with soil and crop characteristics is useful in determining irrigation demands during the growing season. Procedure of how to utilize PET for estimating irrigation needs was outlined for Puerto Rico by Goyal.^{2,3}

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²Goyal, M. R. 1988. Potential evapotranspiration for the south coast of Puerto Rico with Hargreaves-Samani technique. *J. Agric. Univ. P.R.*, 72(1): 57-63.

³Goyal, M. R., E. A. González and C. Chao de Báez, 1988. Temperature versus elevation relationships for Puerto Rico. *J. Agric. Univ. P.R.* 72 (3): 449-67.

⁴Ravaló, E J., M. R. Goyal and C. R. Almodóvar, 1986. Average monthly and annual rainfall distribution in Puerto Rico. *J. Agric. Univ. P.R.*, 70 (4): 267-75.

TABLE 1.—Estimation of monthly potential evapotranspiration in Puerto Rico (mm/month)

Weather Station	Potential evapotranspiration, mm/month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Aceituna	94.5	98.2	128.6	138.6	139.9	138.1	143.0	140.2	131.5	119.3	100.4	88.3	1460.7
Adjuntas	100.6	103.1	134.9	143.9	146.9	144.8	149.2	146.2	137.1	125.8	104.8	97.7	1534.6
Barceloneta													
NNW	112.8	115.4	147.5	153.3	160.2	157.4	164.3	158.8	150.0	138.1	115.3	109.5	1682.5
Bayamón													
Hato Tejas	111.7	114.3	146.8	1526	159.4	156.7	163.5	158.1	148.6	137.4	114.7	108.5	1672.4
Cabo Rojo	111.2	113.5	145.8	151.8	158.3	155.6	162.0	156.9	148.3	136.5	114.5	108.2	1662.5
Calero Camp	111.2	113.5	146.4	151.8	158.3	156.4	162.3	156.9	148.3	136.5	114.5	108.2	1664.3
Caonillas													
Villalba	108.2	110.6	143.3	149.3	155.7	156.2	159.0	153.7	145.2	133.6	111.5	105.4	1627.8
Carite Plant I	104.8	107.6	139.6	147.2	151.6	149.1	155.6	151.6	141.5	130.2	109.1	102.6	1590.4
Cataño	113.6	115.7	148.7	152.9	160.9	157.8	164.6	159.2	150.4	139.0	116.4	109.8	1688.1
Central San													
Francisco	113.6	115.7	147.8	153.6	160.5	157.8	164.6	159.2	150.4	139.0	116.1	109.8	1688.1
Coamo Dam	111.4	114.3	146.8	152.6	159.4	156.7	163.5	157.3	148.6	136.8	114.7	108.5	1670.7
Ensenada	113.6	115.7	147.8	153.6	160.9	157.8	164.6	159.2	150.4	139.0	116.1	109.8	1688.5
Guajataca													
Dam	107.5	110.3	143.0	149.0	155.4	152.0	158.6	153.3	144.9	133.3	111.2	105.1	1623.3
Guayabal													
Reservoir	111.2	113.8	146.1	151.8	159.1	147.0	162.0	157.7	147.9	136.8	114.5	107.4	1655.3
Guayanilla	113.6	115.7	147.8	153.6	160.5	157.8	164.6	158.1	149.4	138.1	115.3	109.0	1683.6
Gurabo	112.2	114.6	147.1	152.6	159.8	156.7	162.7	158.4	148.6	137.4	115.6	108.7	1674.6
Indiera Baja	89.4	93.1	123.0	134.3	135.0	132.5	136.5	134.6	126.3	119.5	98.5	87.9	1407.8
Jájome Alto	92.4	96.1	126.9	137.2	138.5	136.7	140.8	138.0	128.8	118.2	98.3	90.8	1442.9
La Fé	112.2	114.6	147.8	152.6	159.0	157.1	162.7	158.4	149.0	137.8	115.6	108.7	1675.4
Maricao	100.6	103.1	134.9	143.3	146.9	144.8	149.2	146.2	137.1	125.8	104.8	97.7	1534.6
Maricao Fish													
Hatchery	100.6	103.1	134.9	143.3	146.9	144.8	149.2	146.2	137.1	125.8	104.8	97.7	1534.6

Matrullas Dam	115.5	117.9	152.4	163.2	170.0	166.9	174.2	168.2	157.3	143.9	120.9	112.8	1763.2
Maunabo 1 SW	112.8	115.7	148.5	153.3	161.3	158.6	164.3	159.2	149.3	138.4	116.1	109.8	1687.1
Mora Camp	109.8	112.2	144.7	154.3	161.9	156.9	161.7	155.9	144.7	128.7	106.7	112.6	1650.1
Naguabo 6 W	112.5	114.9	148.1	152.9	160.2	158.2	163.9	158.8	149.0	138.1	115.8	109.0	1681.4
Paraiso	112.2	114.6	147.8	152.6	159.0	157.1	162.7	158.4	149.0	137.8	115.6	108.7	1675.4
Peñuelas Salto													
Garza	103.2	106.5	137.6	145.8	150.2	148.1	153.3	149.4	140.1	128.3	107.7	101.0	1571.3
Puerto Real	113.1	116.0	147.8	153.6	160.9	157.8	164.6	159.5	150.4	138.4	116.4	110.1	1688.5
Río Blanco													
Lower	112.0	14.6	147.1	152.9	159.8	157.1	163.9	158.4	149.0	137.8	115.0	108.7	1676.3
Río Blanco													
Upper	100.9	103.7	135.2	143.6	147.6	145.2	150.4	146.5	137.8	126.1	105.1	98.0	1540.2
San Lorenzo													
Espino	102.2	105.5	136.9	145.1									
149.4	146.2	151.8	151.8	139.5	127.7	107.0	100.0	1559.2					
San													
Sebastián	111.4	114.1	146.4	152.2	149.4	156.4	163.2	158.1	148.3	137.1	114.7	107.7	1669.0
Santa Isabel													
3 NW	113.6	115.7	147.8	153.6	160.5	157.8	164.6	159.2	148.1	132.2	110.2	115.5	1678.9
Santa Rita	111.7	114.3	146.8	152.6	159.8	156.7	163.5	158.1	149.4	137.4	115.0	108.5	1673.8
Toa Baja													
Constancia	112.8	115.7	148.5	153.3	161.3	158.6	164.3	159.2	149.3	138.4	116.1	109.8	1687.1
Toro Negro													
Plant 2	93.7	97.4	128.5	138.3	140.4	137.7	141.9	139.1	130.5	119.4	99.4	92.0	1458.2
Villalba	108.2	111.6	144.0	150.1	156.4	153.8	160.1	155.2	145.6	133.9	112.6	105.6	1637.8
Yabucoa 1													
NNE	112.5	114.9	148.9	152.9	160.2	158.2	163.9	158.8	149.0	138.1	115.8	109.0	1681.4
Yauco 1 S	113.6	115.7	147.8	153.6	160.9	157.8	164.6	159.2	148.1	132.2	110.2	109.8	1673.6